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REPORT

OF THE

First International Otological Society.

NEW YORK, SEPTEMBER, 1876.

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PUBLISHED BY A COMMITTEE COMPOSED OF

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25714

ALPHABETICAL LIST OF MEMBERS

OF THE

INTERNATIONAL OTOLOGICAL SOCIETY.

AGNEW, C. R., New York City.
ALT, A., New York City.
BARTLETT, E. W., Milwaukee, Wis.
BLAKE, C. J., Boston, Mass.
BLITZ, A., Nashville, Tenn.
BUCK, A. H., New York City.
BURNETT, C. H., Philadelphia, Pa.
DILLS, T. J., New York City.
DODGE, S., Halifax, N. S.
DUDLEY, D. E., Manila, Philippine Islands.
DYER, E., Pittsburg, Pa.
GREENE, J. ORNE, Boston, Mass.
HAZEN, E. H., Davenport, Iowa.
HINTON, J. H., New York City.
HJORT, Johan, Christiania, Norway.
HOLCOMBE, WILLIAM F., New York City.
HOLMES, E. L., Chicago, Ill.
HUNT, D., Boston, Mass.
JONES, S. J., Chicago, Ill.
KIPP, C. J., Newark, N. J.
KNAPP, H., New York City.
LÖWENBERG, N., Paris.
MATHEWSON, A., Brooklyn, N. Y.
MILLER, H. G., Providence, R. I.
MOOS, S., Heidelberg.
NOYES, H. D., New York City.
NOYES, J. F., Detroit, Mich.
PINKNEY, H., New York City.
POLITZER, A., Vienna.

MINUTES.

In the spring of 1876 the following invitation was sent to certain members of the medical profession to whom it was thought that it would be of special interest:

AMERICAN OTOLOGICAL SOCIETY.

The year 1876, being the Centennial Anniversary of the Independence of the United States of America, will be celebrated by an International Exposition in Philadelphia, and by the assembling of numerous International Congresses, among others of an International Medical Congress in Philadelphia, and of the International Ophthalmological Congress in New York. Believing that these events will bring to this country a number of gentlemen who take an active interest in Otology, and being desirous of taking advantage of this favorable opportunity for the institution of an International Otological Congress, the American Otological Society has deemed it expedient not only to hold its own annual meeting in New York City, on Friday, September 15, but also to issue a call for the assemblage of an International Congress on the same day directly after the probable adjournment of the Ophthalmological Congress.

You are therefore respectfully invited to meet the members of the American Otological Society, in New York City, at 10 A. M., of September 15, 1876, for the purpose of instituting and carrying on an International Congress of Otology.

Members of the medical profession who take an active interest in Otology will also be invited, through the medium of the medical press of this and other countries, to attend this Congress, but your services in this department of medical science have led us to specially invite you to be present and to furnish a paper on some subject in Otology.

A reply to any member of our committee on or before May 15, 1876, will facilitate the efforts to make complete and pleasant arrangements for the reception of delegates.

D. B. ST. J. ROOSA,
20 East Thirtieth Street, New York, N. Y.
CLARENCE J. BLAKE,
Hotel Berkeley, Boston, Mass.
HERMAN KNAPP,
25 West Twenty-fourth Street, New York, N. Y.
J. ORNE GREEN,
12 Beacon Street, Boston, Mass.

tended to be printed, minutes of the meetings, decisions of the society, and correspondence. All other communications and objects presented to the society by its members shall be returned to them at the end of the session.

The archives and funds of the society shall be in charge of the Secretary, who, at the close of each session, shall transmit them to the Secretary appointed for the next session.

13. The decisions of the society shall be taken *vivâ voce*—a ballot may be demanded by five members.

14. The following order of business shall be observed in each session, unless otherwise decided by a majority of members present:

1. Reading of minutes of preceding session by the Secretary.
2. Election of members and appointment of committees.
3. Reading of correspondence.
4. Reading of reports presented to the society.
5. Presentation of papers.
6. Presentation of apparatus or specimens.
7. Verbal communications.
8. Determination of the order of the day for the following meeting.

15. After the reading and discussion of each paper presented, the society shall decide as to whether it shall be referred to the publishing committee.

16. The above rules may be altered or annulled by a majority consisting of two thirds of the members present.

The committee further reported by advising that, as a basis of organization, all members of the American Otological Society present, or who had signed the register of the International Otological Society, be admitted to membership without ballot. Adopted.

The committee then presented a list of officers to be elected by ballot, in which all those who had registered were invited to join. The following were declared duly elected: D. B. St. John Roosa, M. D., New York City, President; E. L. Holmes, M. D., Chicago, Ills., 1st Vice-President; A. H. Buck, M. D., New York City, 2d Vice-President; J. S. Prout, M. D., Brooklyn, N. Y., Secretary and Treasurer; C. J. Kipp, M. D., Newark, N. J., Corresponding and Assistant Secretary.

A committee on business and membership was then appointed composed of Drs. C. H. Burnett, C. J. Blake, and S. J. Jones, after which the society adjourned for one hour.

The committee further recommended the appointment of the following publication committee: Drs. Arthur Mathewson and J. D. Rushmore, together with the Secretary and Assistant Secretary. Adopted.

The following list of papers was also reported by the same committee, some of which were read in full, some in abstract, and others by title. There was time for very little discussion on any of them:

1. A Case of Aspergillus in the Tympanic Cavity. C. H. Burnett, M. D.

2. On Primary Periostitis of the Mastoid Process. H. Knapp, M. D.

3. Certain Modifications of the Usual Methods of Treatment of Chronic Non-Suppurative Inflammation of the Middle Ear. S. J. Jones, M. D.

4. A Case of Exostosis of the External Meatus operated on by the Dental Lathe. Dr. A. Mathewson.

5. A Case of Plastic Operation on the Auricle. Dr. A. Mathewson.

6. Test-Sentences for determining the Hearing Power. A. H. Buck, M. D.

7. Two Cases of Acute Inflammation of the Membrane of Schrapnell A. H. Buck, M. D.

8. A Sketch of the Early Development of the Ear with a New Account of the Development of the Meatus Auditorius Externus, Membrana Tympani, and Middle Ear. D. Hunt, M. D.

9. Hyperostosis of the Mastoid. J. Orne Green, M. D.

10. On Gaseous Interchange in the Tympanic Cavity, Physiological Considerations, and Therapeutic Applications. N. Löwenberg, Paris.

11. A Case of Abscess over the Mastoid Region, extending to the Squamous Portion of the Temporal Bone and involving the Brain without Harm to the Auditory Apparatus. O. D. Pomeroy, M. D.

12. Paper Dressings for Perforations of the Membrana Tympani. C. J. Blake, M. D.

13. Remarkable Case of Vertigo, following an Injury of the Middle Ear. E. L. Holmes, M. D.

14. Perforation of the Membrana Tympani with no Premonitory Symptom. E. L. Holmes, M. D.

15. On Syphilitic Disease of the Labyrinth. D. B. St. John Roosa, M. D.

16. Report on Progress of Otology, prepared for the American Otological Society. Drs. C. H. Burnett, of Philadelphia, and C. J. Blake, of Boston.

Dr. Knapp from the Committee on Organization introduced the following resolution, which was adopted:

REPORT ON THE PROGRESS OF OTOLOGY, 1875–1876.

PART I.

Anatomy and Physiology.

By CHARLES H. BURNETT, M. D., Philadelphia.

Dr. Urbantschitsch has reported the following interesting case of peculiar epithelial formation on the membrana tympani:

A physician in Vienna consulted him for a purulent otitis externa diffusa. The examination revealed a perforation of the membrana tympani in the under segment. The case was treated with astringents, and in two months all purulent symptoms disappeared.

A month later, the disease in the external canal had entirely gone, but the drum-head, which was in the main entirely normal, showed here and there several shining, white, and well-defined deposits, as though it were set with small pearls at these points.

A second case with similar appearances was observed by Dr. Urbantschitsch in a man fifty years old. Touching these bodies with a probe revealed that they were very hard, and a tenotome was with difficulty pushed through them. Portions of these growths, examined under the microscope, revealed the presence of epithelium only. Cholesterine was absent, as shown by the microscope, and by chemical tests of sulphuric acid and iodine.

The first-mentioned case was examined by Dr. Urban-

server could see the entire nasal cavity, and the naso-pharyngeal space at a glance, thus taking in at one time the whole tract from one tubal lip to the other, and from the insertion of the velum on one side to that on the other. By introducing a laryngeal mirror into the naso-pharynx the changes in the mouth of the tube were observed.

The following views were obtained:

a. At rest. In the bright-gray fundus of the mouth, the walls lie close upon each other, thus forming a bright-gray furrow, running from above downward, terminating on the floor in a small triangle.

b. When swallowing occurs, an undulation takes place in the lower part of the mouth of the tube, beginning at the side nearest the nostrils. First there is a hollowing out, then an elevation of the floor into the opening of the tube, and at the moment of the greatest elevation of the same and of the tubal lip at the height of the act of swallowing, then for the first time the tubal cleft opens. It gapes first and widest below in the shape of a black triangle, the apex of which runs out into a black line which marks the upper boundary of the tubal cleft. Immediately after the structures fall back again to their position, and the wide cleft, which is not always of the same dimensions, disappears, and the fundus of the mouth of the tube is again bright gray in appearance.

c. Phonation. During phonation the posterior tubal wall is uniformly moved backward, pushed away and up from the anterior wall of the canal, by the wedging in between them of the floor of the mouth of the tube. Only in singing a high *i*, or *e* (German), does the floor of the canal rise so high as to cause the cleft of the tube to become so narrow as to obliterate the triangle which usually appears at an ordinary act of swallowing.

At such a time the tubal ridge (cartilage) and the velum are thrown into such lively vibrations, that one can easily see how these motions can be conveyed to the bony tympanic cavity and become the cause for the humming and buzzing experienced in the ear when *i* is sounded loudly and held.

The cracking noise heard on swallowing may also be partly accounted for by the movement of the tubal cartilage.—(*See* review by Zaufal, *Archives of Otology*, vol. xi., pp. 61, 62.)

Prof. Rüdinger's observations on the individual differences in the size of the jugular fossa have been conducted upon the skulls of one hundred and two adults (men, chimpanzees, and gorillas). The results are that seventy times the jugular foramen was larger on the right side, twenty-seven times on the left; only four in one hundred human skulls presented equal openings on each side. The least difference was one millimetre; the largest, sixteen millimetres. The conclusions are: 1. Both jugular foramina are, in their normal state, unequally broad and deep. 2. This difference in size is neither the result of a malformation nor of an osseous or suture-change in the petrous part of the temporal bone and its surroundings. 3. The difference in size is the result of the peculiar condition of the sinus of the dura mater, which depends upon the variable quantity of blood, flowing on one side from the surface of the brain, and on the other from the cavities of the brain. 4. The wide fossa jugularis on the pars petrosa appears to be an individual peculiarity, which interferes neither with the circulation of the blood within the cavity of the skull nor with the functions of the organ of hearing.

Prof. Gruber has found in a temporal bone in his cabinet a rare anomaly, consisting in a deficiency in the bone, extending from the jugular foramen upward and backward. This opening is of irregular oval shape, one cm. long by three-quarters of a cm. wide, and lies between the styloid process and mastoid incisure. Its irregular edge would seem to indicate that it was not a passage-way for a blood-vessel, but, rather, that it is purely a pathological process. The most important consideration is that the sinus beneath it was covered only by soft parts, and an ordinary incision with a bistoury for the opening of a deep abscess beneath the mastoid process might have penetrated the sinus.

Urbantschitsch has pointed out some variations in shape and position in the pharyngeal mouth of the Eustachian tube of man. There may be great differences at these points in the same person, as well as in those of the same age. These differences are found only in the lower ends of the cartilaginous walls of the tube. These walls may form at the mouth of the tube, and only there, acute, right, or obtuse angles with each

other, or the anterior wall may be a mere button-like projection from the posterior wall. Be it remembered that the variations are found only in the cartilage of the tube at its pharyngeal end; above this point, a transverse section of the canal *always* reveals the well-known shape of a shepherd's crook.

These differences may, however, influence the shape of the pharyngeal mouth of the Eustachian tube. In some cases, the shape and position of the membranous part of the anterior wall of the tube influence the calibre of the canal. The variations in this part of the tube may be in the form of an elevation or a depression, and are due to irregularities in the position of the inner lamella of the pterygoid process of the sphenoid bone, which sometimes ends immediately at the lateral, i. e., anterior cartilage of the tube; but in others extends further backward and downward.

In the first instance, the membranous tube sinks forward into the pterygoid fossa, while in the second instance the unusually low-descending lamella produces a prominence in the membranous tube. As a rule, the pharyngeal mouth is shaped like a pear, its base being sometimes upward, in other cases downward. In some individuals the ostium pharyngeum is kidney-shaped. These deviations in shape are, according to our author, due to the ligamentum salpingo-palatinum of Zuckerkandl, which runs from the anterior wall of the tube to the palate. To these fibres, according to Urbantschitsch, a series of fibres runs forward from the ligamentum salpingo-pharyngeum, which arises from the under end of the inner or posterior cartilaginous wall of the tube, and the two sets modify the shape of the mouth of the tube. Zuckerkandl, having had an opportunity of examining the Eustachian tube of an elephant twenty-six years old, the petrous portion of which had, unfortunately, been destroyed, gives, however, some interesting comparative points of difference in the cartilaginous or pharyngeal part of this animal's tube. The naso-pharyngeal space is comparatively small. The ostium pharyngeum is not found by ordinary inspection, as its position is not marked by any anatomical prominence. Careful search must be made for it, when the course of the tube will be found to be nearly at right angles toward the tympanic cavity. The length

vation, the ambilateral changes of position in the tubes form with the velum palati an appearance of a half moon, convex upward, the sloping points of which are received by the mouths of tubes.

The first fact learned by the observation of this case teaches that the mouth of the tube is widened in a direction backward and inward, but narrowed from above downward, during the acts named. The question whether the united effect of both these motions brings about an opening or a closure of the mouth of the tube is next considered. By his observation of the case allnded to, Prof. Lucæ is convinced that the mouth of the tube is narrowed, i. e., closed, by swallowing and phonation, which is in accord with the views of Michel. By placing a few drops of water in the mouth of the Eustachian tube of the patient, it was seen that every act of phonation or swallowing caused the water to flow from the mouth of the tube into the pharynx and nostril, which result tends to prove that the tube was closed rather than opened by these acts, for, were it opened thereby, the water would have run backward into the tube and not out into the pharynx and nose. This closure of the tube seemed to extend about one and a half cm.

Prof. Lucæ next considers the objective investigations on which rests the theory that the tube is opened by swallowing. 1. The opinions respecting the function of the tensor palati mollis, as set forth by Valsalva and Rüdinger, are now held by most authors, viz., that it is a dilator of the tube. 2. The functions of the levator palati mollis are not so clearly defined, and the opinions on the subject are very diverse. The most general opinion, however, respecting this muscle, is, that when it contracts it must narrow the mouth of the tube. This narrowing, and consequent compression of the air, is so marked that it may bring about a positive oscillation in the air of the tympanic cavity, which is especially well seen by a bulging of the membrana tympani in cases of its partial atrophy and consequent abnormal mobility. Therefore, the levator palati is considered, so far as concerns its relations to the tube, as an antagonist of the tensor palati, which is the view of Tortual, Von Tröltsch, Politzer, *et al.*

In swallowing, it is conceded that the levator palati lifts the soft palate and narrows the mouth of the tube; functions fully shown by the observations of Michel and others.

Concerning the tensor palati, Prof. Lucæ thinks it has not yet been proven that it opens the tube during swallowing, but he thinks it highly probable that "this muscle, right after the completed act of swallowing, participates in the reopening of the tube, occurring simultaneously with the cessation of the action of the levator palati and the sinking back of the velum."

Prof. Lucæ then shows, by manometric experiments on persons with pervious tubes but perforated drum-heads, that the first effect of swallowing, phonation, forced respiration, and aspiration, is to cause a positive oscillation in the manometric column. This is due "to the composite atmospheric oscillation which occurs in the naso-pharynx by the elevation of the velum, and extends to the ear through the tubes."

Although Prof. Lucæ proposes these explanations for what he terms error in the previous view concerning the mechanism of the tube, he does not deny that, during the act of swallowing, the tubal muscles bring about a physiological ventilation of the ear. This ventilation of the ear is not brought about, according to this observer, by the opening of the usually closed tube, at swallowing, but by the fact that the usually patulous mouth of the quite loosely closed membranous-cartilaginous tube is powerfully compressed by swallowing, and after the act is opened again.

The practical deductions drawn from these studies by Prof. Lucæ are: That we may blow air into the middle ear by employing a movement which will cause the velum palati to hermetically close the naso-pharyngeal space. Such a process may be effected by prolonged phonation of the vowel *a*, which will cause the velum to rise, cut off the upper from the lower pharynx, and during this act air may be blown into the nares, and thence into the middle ear, by a powerful inflation with the hand-balloon.

Prof. Lucæ considers, both theoretically and experimentally, the question whether "the Eustachian tube is usually

The latter function is thus explained by Prof. Lucæ: If the membrana tympani of a person of normal hearing be examined during the act of blowing the nose, which is an act midway between ordinary expiration and the Valsalvan inflation, the membrane will be seen to move very distinctly, without any simultaneous act of swallowing. Further, if the membrana tympani of a person of normal hearing be examined while his head is firmly fixed, it will be seen that, at each expiratory impulse produced by blowing the nose, the membrana tympani will bulge, especially at the upper and hinder quadrant. It will also be observed that, with the cessation of this expiratory effort, the membrana tympani will return, without any act of swallowing, to its normal position with more or less rapidity.

The conclusions reached by this observer are, that the Eustachian tube is not to be regarded as a usually completely open tube, nor must we consider it an hermetically closed one. "It is, rather, a *loosely closed* tube, which is opened with more or less ease, according to individual peculiarities, by fluctuations of atmospheric pressure in the naso-pharynx and the tympanic cavity," which theory, according to Prof. Lucæ, is perfectly tenable in view of the acoustic theory of audition, as well as in harmony with the experiments just alluded to.

After the removal of a large tumor from, and a portion of, the right superior maxilla of a man twenty-three years old, Nicoladoni was able to observe by direct inspection the movements of the mouth of the left Eustachian tube.

This observer says: "Simultaneously with the contact of the soft palate with the posterior wall of the pharynx, whereby the hinder surface of the velum lay almost in the same plane with the floor of the nares, the median or posterior wall of the tube, one cm. high, began its movement while the anterior or lateral wall apparently remained still. The rather rapid motion of this part consisted in the backward and slightly inward movement of the under prominent edge of the medial plate of the tube, three millimetres from its position of rest; at the same time, the lower boundary of the fossa of Rosenmüller became tightly stretched, and assumed the form of a salpingo-pharyngeal arch, with an oblique plane,

open, then an explanation of the above-named sound on inflation, by Valsalva's method, must be looked for in the increased tension of the drum-head by the augmented intra-tympanal pressure.

This latter explanation is, in the opinion of Prof. Flemming, entirely inadmissible, for the following reasons:

1. On account of the several cases of apparent continued patulence of the tube, and the consequent autophony, observed by Poorten, Rüdinger, and Yule, upon themselves.

2. Similar results as to autophony, produced by the patulence of the tube, kept up by the use of the catheter, on others.

Our author states that he has been able, ever since childhood, to voluntarily open his Eustachian tube by certain muscular efforts, in a way which he cannot accurately explain. This action is not at all like the act of swallowing, and can be carried out whether nose and mouth are closed or opened, during inspiration, expiration, or during a pause in respiration, and upon one side at a time, or on both sides.

When free from catarrh the tube can be thus held open several minutes, during which time each inspiration and expiration can be heard as a loud, roaring sound.

When the tongue is depressed for the purpose of examining the pharynx, this peculiar act is performed easily only during expiration. It can be done with great difficulty, however, during inspiration, but the tube cannot at such a time be held open. This muscular act is always accompanied by the well-known cracking in the ear, which is always a little in advance of the opening of the tube.

The sensation in the drum and the resonance perceived upon phonation, whenever this voluntary act on the part of the author is carried out, are unmistakably and completely identical with those brought about in him by the Valsalvan inflation, and a simultaneous act of phonation. It is fair to conclude, then, that their cause is the same. But this cause cannot lie in an increase of intra-tympanal pressure and tension of the drum-head, for in the case just narrated such a condition of pressure cannot exist, since both mouth and nose are open. The author, therefore, says: "Whoever continues

irregular. The general form of the anvil resembled the so-called body of the anvil, inasmuch as the processes were shorter and thicker than the normal. The articular surface of the incus was perfectly normal.

The stapes could not be found, but, as the other two ossicles were found, it is supposed by the author that the stapes was destroyed in the dissection. The fenestræ were normal. The tympanic bone was attached to a fossa in front of the round window, and externally to the posterior edge of the ramus of the lower jaw, by a ligament 8 mm. long at a point 14.5 mm. from inferior maxillary articulation. On the inner surface of the petrous bone was a porus acusticus internus, covered, however, with connective tissue, and ending in the substance of the bone. The inner mouth of the Fallopian canal was also wanting.

The four conclusions of the author are:

1. The tympanic canal represents the primitive tympanic cavity, or, in other words, the original second visceral cleft, i. e., the cleft between the first and second arches which, on one side, were transformed into a secondary mouth (throat).

2. In this transformation of osseous structures, the styloid process, the osseous Eustachian tube, and the bulla ossea, do not appear.

3. Instead of these we find supernumerary bones, the accessory under-jaw, and the accessory hyoid bone.

4. The position of the auditory ossicles outside of the malformed tympanum is explained by the fact that, in a normally developing fœtus, they are found outside of the first visceral cleft.

The accessory throat of this animal represents the primitive tympanum, and the bulla ossea, which forms later, is entirely transformed into an entirely different bone, so that the position of the ossicula auditus outside of the tympanic apparatus must be regarded as a necessary consequence of the primitive formation.

We must, therefore, conclude that the entirely irregularly formed tympanic canal, with its under-jaw and lips, represents the primitive tympanic cavity, which anomaly was brought about not by hinderance, nor yet by external mechanical forces,

nor by emotions of the mother, but according to the principles of antholysis, i. e., by a mode of development regular as to its law, but unusual as to its situation.

There were many other anomalies in this case, as may be supposed, connected with the throat-muscles and neighboring parts, which your reporter has not thought necessary to mention here further than to say that they are of interest especially to the zoölogist.

Dr. Urbantschitsch has made a series of measurements of the ossicles of hearing, and has come to the following averages:

The Hammer.—The length of the malleus varies between 7.0 mm. and 9.2 mm., its average being about 8.5 mm. The short process varies from 1.2 to 2.6 mm., being on the average about 1.6 mm. long. In two exceptional cases the Folian process was found to be as long as 2.5 mm. in a person thirty years old, and 5.8 mm. in a man twenty years old. The handle of the hammer, from the short process to the tip, varies from 4.2 to 5.6 mm.; average, 5.0 mm.

The Anvil.—The distance of the upper end of the anvil's articular surface from the free end of the horizontal ramus is from 4.8 to 6.3 mm.; average, 5.3 mm. The under articular surface is from 3.0 to 5.2 mm. distant from the anvil-stirrup joint; average, 4.6 mm.

The Stirrup.—The length of the stirrup amounts to 3.2 to 4.5 mm.; average, 3.7 mm. Its width, taken exactly between the two rami, varies from 1.8 to 3.5 mm.; average, 2.3 mm. Other measurements are given of various parts of the stapes and of the other ossicles. All evince a large amount of careful and accurate research, but space and time will not permit a fuller detail of them at this place.

Dr. Weber-Liel has recently published the results of his investigations concerning the functions of the membrane of the round window. These experimental investigations were conducted with a view of determining that the membrane of the round window participates directly in the waves of sound transmitted to the air of the tympanum by the membrana tympani. Johannes Müller inclined to this opinion, but the experiments of Schmiedekam and Hensen tended to decide the question the other way.

tion of sound-waves from the oval window (i. e., foot-plate of the stapes) through the labyrinth to the membrana tympani secundaria, the labyrinth was opened and the vestibule exposed from behind. After the fluid of the labyrinth had escaped, sound-waves, conducted by the membrana tympani to the labyrinth, produced no visible effect on the membrana tympani secundaria. This negative result is attributable to the loss of pressure consequent upon the escape of the labyrinth-fluid.

For, when the cochlea was sawed transversely through, and a narrow glass tube placed in the thus transversely-cut scala tympani, so that both in the tube and the scala, to which it was joined, the column of water could be elevated and depressed at will, once more pressure was brought to bear upon the labyrinth side of the membrane of the round window. Upon now closing the tympanic cavity, excursions became once more visible when the sounds of organ-pipes or the voice were conveyed to the ear.

In 1860 Politzer showed that the tensor tympani is supplied by a branch of the motor division of the fifth nerve (*Meissner's Jahresbericht*, p. 583). Lately, Voltolini ("Virchow's Archiv," Band lxv., p. 467) performed a series of experiments, which have led him to the following conclusions:

1. "Irritation (by electricity) of the trigeminus produces distinct and powerful contractions of the tensor tympani, which can be kept up for some time on the dead animal; these contractions can almost always be produced, even by weak streams of electricity."

IV. "With some of the preparations a glass tube was cemented to the temporal bone, and through this tube (the labyrinth being undisturbed), by means of a rubber pipe, sound-vibrations were conveyed to the bones of the head. No excursions were perceptible, either with the tympanum opened or closed."

2. The same result can be obtained by irritation of the facialis, but usually only by strong electric currents, and the irritability is generally soon lost.

3. During this contraction of the tensor the drum-head is drawn strongly inward by means of the manubrium; but, of course, these excursions of the drum-head vary in different

animals; in Guinea-pigs they are so small as to be undistinguishable unless one uses an indicator, fastened to the membrana tympani.

4. During such a contraction of the tensor, and the consequent tension of the membrana tympani, a simultaneous ascent of the lymph, in an opened semicircular canal, becomes visible in the dead animal, and when the tension is removed the fluid sinks back.

5. In no instance, neither by excitation of the trigeminus nor of the facial nerve, nor even by mechanical movement of the stirrup, was a simultaneous movement in the membrana tympani secundaria visible, not even by microscopic observation of a reflection, or of an indicator attached to the membrane.

6. During irritation of the trigeminus, and the consequent contraction of the tensor tympani, there ensues a contraction of the palatal muscles, and an opening of the Eustachian tube, for the anterior membranous wall is drawn away from the posterior cartilaginous tubal ridge. The fact that the tensor tympani can be put into motion by excitation of two cerebral nerves, as above stated, may, according to Voltolini, be used as an explanation of the power the muscle has of both voluntary and involuntary movement. In one of his experiments Voltolini observed that excitation of the facial nerve produced contractions in the tensor tympani and stapedius muscles. "Such a process," says the observer, "is of the highest importance in the act of hearing, if indeed such a process occur in the living ear, which is not to be doubted; in such an event the stapedius muscle acts as a check on the movement of the hammer (*loc. cit.*, p. 479). The reflex movements of the tensor may be accounted for by the branch of the trigeminus which passes through the otic ganglion." Then arises, as Voltolini suggests, the important question, whether the fibre from the facial nerve, supplying the tensor, also passes through the otic ganglion, or goes directly from the facialis to the muscle; in the latter case the muscle would evidently possess the power of voluntary motion. Although no one has demonstrated that a branch of the facial nerve does pass directly to the tensor tympani, the muscle certainly possesses the power of vol-

about the middle and running instantly to the tip. This occurred whenever the cotton swab was turned and pressed upward and forward. The same kind of sensation, though less intense, occurred whenever astringents were poured into the external auditory canal. At no time was any sensation of taste excited. The writer expresses the opinion that this sensation was the result of mechanical irritation in one instance, and in the other of chemical irritation of the chorda tympani.

"There is," says Dr. Carl, "no other nerve in this region which could be responsible for such a phenomenon, and furthermore, I believed, from this experiment, there were no gustatory fibres in the chorda, for, if its sensible fibres respond to an excitation, why should not the fibres of taste, which might be there also, reply to irritation? . . . . How great was my astonishment when Prof. Fisk, my honored instructor, whom I had made acquainted with the facts of the case, in testing the anterior parts of the tongue, found complete loss of taste for everything on the left side."

In recapitulation the author says: "This is a case which presents, with a chronic destructive process confined to the tympanic cavity, a distinctly circumscribed paralysis of taste on the corresponding side of the tongue. At the same time, nevertheless, the ordinary sensibility of the tongue is not only intact, as is seen when adequate stimulation is used, but also irritation of the chorda tympani in the tympanum produces sensations on the corresponding parts of the tongue. . . . I also believe I am justified in supposing that the pathological process is, so far, confined to the cavum tympani, because there are no symptoms which point to its passage into the deeper parts of the petrous bone. The facial nerve is normal, and the inner ear retains its function, as shown by tests of tuning-fork and watch."

There have been no hæmorrhages from the ear; but Dr. Carl believes the disease of the tympanum and the paralysis of taste are not independent of each other; in fact, he thinks the latter is entirely dependent on the former. He further states that "it is absurd to suppose that a pathological process in the tympanum could have destroyed part of the fibres of

the chorda, and left the rest whole. Suppose an explanation of the process is sought in the ulceration of the mucous membrane covering the nerves which pass through the tympanic cavity, and a consequent atrophy, brought about by pressure from inspissated pus, etc., still a partial and, physiologically, a circumscribed destruction of the chorda seems impossible. And, since the sensible and secretory elements of the chorda are promptly stimulated, the natural conclusion follows that no lesion in the chorda tympani has occurred." The observer then propounds the question, "What nerves are there in the drum-cavity, the destruction of which could bring about paralysis of taste?"

And he comes to these conclusions:

"The course pursued by the gustatory fibres running from the anterior part of the tongue to the brain are, in short, as follows: They first enter the lingual branch of the trigeminus, and, while most of them, as I believe, reach the glossopharyngeus by the way of the otic ganglion, petrosus superficialis minor, tympanic plexus, and petrosal ganglion, perhaps a small amount of them, varying in individuals, pass into the chorda tympani, and thus, through the tympanic cavity, reach with the chorda the facial nerve, in the tract of which they go to the geniculate ganglion. From this point, under the name of ramus com. nervi fac. complex. tympan., they are distributed to the tympanic plexus, and thus reach, a second time, the pharyngeal nerve in the tympanic cavity, in common with the first-named part, from the otic ganglion. If the tympanic plexus is destroyed, as it would seem to be from what has been said above, it becomes apparent why the chorda remained dumb respecting the sense of taste."

It seems but justice to mention here some of the objections urged by Prof. Voltolini (*M. f. O.*, No. 3, 1876) against the reliability of the observations and deductions made by Dr. Carl.

The case is a very important one, but Prof. Voltolini thinks that an error has been made in the premises, namely, that "the chorda was irritated by the cotton swab." He further states that, in his opinion, the chorda tympani has been destroyed in the diseased tympanum.

"For, if the membrana tympani is entirely gone, as it is according to Dr. Carl's statement, made, presumably, on the authority of Prof. von Tröltsch, who is his physician, then the chorda tympani must be visible, if it be present. The hammer, too, must be destroyed, for, were it still present, Dr. Carl could not have swabbed out his ear so freely without pain. If, then, the membrana tympani and hammer are gone, and the mucous lining diseased by a chronic purulent process of seventeen years' duration, how can the chorda tympani have escaped? This were too much to suppose for so delicate a nerve."

In reply to the theory of Dr. Carl, that the loss of taste might be ascribed to the destruction of Jacobson's nerve on the promontory, Voltolini says: "This nerve is pretty well covered by lying in a relatively deep, bony groove on the promontory, and is it fair to presume that it has been destroyed, while the chorda tympani, normally lying entirely free in the tympanum, should have escaped a destruction which has invaded the membrana tympani and the malleus? . . . . The destruction of the chorda tympani would account for loss of taste, just as it has in other instances. If, notwithstanding the paralysis of taste, sensation was excited when the upper edge of the annulus tympanicus, i. e., the region where the external auditory canal unites with the tympanic cavity, was touched, the case becomes simply one of reflex action."

"How this is," says Voltolini, "cannot be at once shown, but we would mention that the lingual nerve and the auriculo-temporal nerve arise from a common trunk, namely, the sensitive inferior root of the third branch of the trigeminus.

"When the auricular branch of the pneumogastric nerve is irritated in the external auditory canal, patients cough; but they do not cough because they feel a tickling in the ear, but because they feel a tickling in their throat, and yet only the auricular branch has been irritated."

Prof. Eduard Hofmann, of Innsbruck, has corroborated in the main the observations of Wendt and Wreden upon the condition of the ear in a new-born child.

In a paper entitled "Premature Respirations in their Forensic Relations," Prof. Hofmann makes these conclusions:

tic nerve, are sparsely arranged, but they are large, and supplied with long, thick, bristle-shaped cilia ; they increase, however, in number, toward the opposite pole of the aural sac, but decrease in the size, length, and thickness of their cilia, in such regular progression, that in the more distant circuit of this pole close concentric rows of the smallest ciliated cells, with the shortest and most delicate cilia, are found. At the pole opposite to the point of entrance of the acoustic nerve, a lateral view reveals a thickening of the wall of the aural sac, including about one-sixth of the internal surface. Viewed from above, this thickening appears like a spherical disk, around which the smallest cells, just alluded to above, stand in very close circles. The round disk is the acoustic organ in the ear of the pterotrachea. Its middle point is formed of a large cylinder-cell, the broad base of which is raised above the wall of the aural sac. This is named the central or middle cell, and is crowned on its upper surface with a wreath of delicate, closely-placed and stiff rods—*the acoustic rods.* The surface of the cells looks like a horny pad, in which the acoustic rods are placed perpendicularly. Their stiff bases can be traced far into the cells. The relation of the acoustic nerve-fibres to these rods, and to the "middle cell" of the acoustic organ, is remarkable. In front of the point of entrance of the acoustic nerve the fibrillæ spread out beneath the epithelium like meridians on a globe, and run in myriads toward the acoustic organ. There they enter the "middle cell," and it will be seen that each of the rods scattered over the surface of the cell unites with one of the finest acoustic fibrils in the cell.

It cannot, therefore, be doubted that the aforesaid stiff rods must be called the real terminal apparatus of the acoustic nerve, and the "middle cell" a true acoustic cell. The "middle cell" is divided by a relatively wide space, and surrounded by a circle of cylindrical or finger-shaped cells, of which one at least can be certainly shown to be an acoustic cell, crowned with similar acoustic rods.

This circle of acoustic cells is closely surrounded by several concentrically crowded layers of cells, which, on account of their evident connection with auditory nerve-fibrils, may

be styled a *circular ganglion.* To this the compact concen tric circles of the smallest ciliated cells are attached. On fresh living specimens the stiff rods of the acoustic cells, the *acoustic rods*, can be very easily distinguished from cilia.

The acoustic rods are very transparent, uniformly cylin drical, and supplied on top either with a delicate button-like end, or with a circular terminal surface. The cilia are broad at the base, terminating above in a delicate vibratile point, and when in the fresh state are far less transparent.

The action of the cilia in the ear can be studied in the larger transparent specimens during life, without the least injury to the parts, and in the investigation comparatively high power of the microscope can be used. The aural sac lies immediately under the general surface of the body; the under transparent portion of the animal's body acts like a thick object-glass. It will then be seen that the cilia, which, in a state of rest, lie against the inner wall of the labyrinth-sac, with their points turned toward the auditory organ, suddenly rise up, by reflex irritation, when the animal is roused by a sharp sound, and cast the otolith against the acoustic organ.

This change of place on the part of the otolith is brought about by the gradually decreasing length of the cilia in the direction of the acoustic organ; the smallest cilia, which sur round most closely the acoustic organ, are placed opposite the otolith, like bumpers on the railroad-car, in order to break the force of the blow coming against the stiff, immovable acoustic rods.

These observations have been corroborated by later experi ments by Prof. C. Claus, of Vienna. He, however, believes that the small ciliated cells which closely surround the acous tic organ are also true acoustic cells, but this view is not based on observation of the animal in life.

Dr. Hermann Dennert has written an article of the greatest importance respecting testing hearing in cases of unilateral destruction of the cochlea.

He thinks that there must have been some error of obser vation in those cases of destruction of the cochlea, recently reported as retaining hearing on the affected side. He inclines to the opinion of Schwartze that "the probable cause of

the error in these cases lies in the impossibility of complete exclusion of the perfect ear from participating in the hearing of the tests employed."

In the consideration of this subject two points must be borne in mind: 1. Whether a process which destroys the cochlea would leave the structures of the vestibule so far intact as to be able to perceive sound; and, 2. How far these structures, in any case, are concerned in the act of hearing, especially in the perception of speech.

A discussion of such a point the author considers desirable, because an endeavor has been made of late to define the consonants as sounds having fundamental notes with a given pitch; and then, in accordance with the present theory of the function of the cochlea, to ascribe to the latter alone the understanding of speech. The writer then states his views on the mode of hearing in general thus: "We shall not, perhaps, be wrong in supposing that we hear all sounds with the structures of the vestibule, but indistinctly and with undecided limits; the co-operation of the cochlea gives to that which is heard its finer shades, form, etc. We *hear* with the vestibule; we *understand* with the cochlea."

He further states that he is of the opinion that the entire mechanism, from the drum-head to the stirrup, is of importance, chiefly in respect to the acoustic processes in the vestibule, in which, at every in-and-out movement of the stirrup, the vestibular contents are excited summarily as a whole, since the sound-waves as motor forces operate mechanically against the drum-head, as on a plane surface, while in the cochlea the musical tones are immediately taken up. At a future time the author proposes to publish further views on this point.

He does not believe that speech is a simple musical process, and he gives the following reasons: "We often find, in testing hearing, that the perception of speech does not stand in a proportionate relation to the perception of musical notes; further, the improvement which occurs upon using the catheter, or the application of the artificial drum-head, is not always equal for both.

"Again, a number of words, especially those in which a number of consonants occur, remind one so strongly of noises,

that it is difficult to draw a line between a word composed of tones and a noise. Hence it would be necessary to resolve every perceived sound in the cochlea, a supposition against which the occurrence of vestibular structures in animals without a cochlea would necessarily militate."

He therefore concludes that a perfect coöperation of vestibule and cochlea is necessary for perfect hearing, and he also thinks that those cases have been incorrectly observed in which, though the cochlea is lost, hearing was said to be good, *and that the apparent hearing in the diseased ear is due to the perception of sound in the good ear.* This he has conclusively proved by a case recently observed in the clinic of Prof. Lucæ, of Berlin. Without giving the particulars, it is only necessary to state that Dr. Dennert removed from the right auditory canal of a boy, seven years old, a sequestrum, which on examination proved to be the entire cochlea, with a part of the vestibule. The hearing, tested immediately after the removal of the cochlea, as well as repeatedly afterward, always gave the same result. The boy, with his good ear firmly stopped, heard most of the numerals repeated in a loud whisper near the affected ear; he also heard ordinary words spoken in moderate tones. He did not hear the ticking of a watch pressed close on the diseased ear, nor did he hear it when the watch was pressed on the mastoid process, nor on the temple. Notes of tuning-forks of various pitch were not perceived, neither with nor without resonators. If the tuning-forks were placed on various parts of the head, the boy could not localize the note in any particular ear, which peculiarity Dr. Dennert has noticed not unfrequently before in cases of positive unilateral and deep disease of the labyrinth. A low whisper the patient could not hear, not even when the cautions detailed below were observed. In order to find out what part the well ear had in hearing speech used as test, Dr. Dennert, together with Prof. Lucæ, tried the following method:

The well ear, which, when firmly stopped and turned toward the source of sound, could still hear, very correctly, a whisper repeated at a distance of six feet, was kept firmly stopped, while the affected ear was alternately stopped and unstopped. The result as to hearing was entirely unaltered

by the alternate opening and closing of the diseased ear. In cases of considerable one-sided deafness, when the perceptive power of the other ear remains good, the above-named observers always test the hearing for speech in the manner just described. "In order to prevent errors arising from the sense of feeling, a thin piece of paper may be held before the ear examined. If it is found that the ear tested hears better, both quantitatively and qualitatively, when opened than when it is closed, the hearing must be ascribed to it; but if the result remains the same with the ear opened and closed, then whatever hearing is found must be ascribed to the other ear.

"This method of testing the hearing is not only important in detecting one-sided deafness, but also for determining the degree of one-sided hardness of hearing, because without these cautions the latter might be considered entirely too slight."

Prof. Lucæ contributes a paper on the same subject, with special reference to the present methods of testing the hearing. He narrates a case of loss of the cochlea, in which there was, apparently, hearing in the diseased ear, but which he shows to have been due to the hearing power of the good ear.

The method employed in testing this case was that already described in the reviews of Dr. Dennert's paper. Prof. Lucæ says: "This case shows that, even when the good ear is closed, a low whisper could not be used as an isolated test for the deaf ear. Patients with normal hearing can hear whispers near their ears when both ears are stopped. This might be considered due to imperfect stoppage of the auditory canal." This may be the case sometimes, but that a low whisper may be heard, even when the auditory canal is absolutely hermetically closed, is shown by the history of a case of congenital deficiency of the auricle and external auditory canal, which was observed by Prof. Lucæ in 1869.

"Siegfried M., twenty-three years old, has always, until the present time, enjoyed good hearing. The latter has become impaired, within a few weeks, on account of a severe cold in the head. His speech is perfect. *On both sides there is complete cartilaginous closure of the auditory canals.* Words spoken with moderate loudness are heard three feet on the right, and four feet on the left side. A whisper is not heard

at all on the right side, but, on the left side, whispered numbers, as, for example, 606, are distinctly heard, when repeated near the auricle. There is chronic naso-pharyngeal catarrh. Auscultation on the mastoid process reveals loud, moist *râles* during inflation of the tympanum with the Eustachian catheter. After the air-douche a low whisper is heard on the right side, near the ear, and on the left side more than one foot and a half."

It is, therefore, says Prof. Lucæ, highly important, if we wish to avoid the grossest errors, that always, in every case of unilateral functional disturbance, the ear to be examined should be alternately closed and opened during the testing with speech. By observing these precautionary measures in the future, a large number of useless remedies and wonderful cases of one-sided deafness will disappear from our literature, as the latter have been really nothing more than permanent improvement in the hearing of the slightly-affected better ear.

This valuable article closes with the remark "that the case of destruction of the cochlea alluded to is of importance in deciding the diagnostic worth of so-called bone-conduction, for it shows that, in unilateral necrosis of the cochlea, the tuning-fork, placed anywhere on the cranium, is by no means uniformly heard only in the well ear."

At the International Congress of Medical Sciences, held at Brussels, September, 1875, Dr. Delstanche, *père*, opened the discussion on "the methods of measuring the hearing and registering its degree in a uniform manner for all countries." The following conclusions were given:

1. In the normal state, the ear perceives indifferently and equally well all the noises which fall upon it, no matter what their nature may be; so that a simple acoumetre (a single sound) might be adopted as a common measure of hearing for all countries.

But, in a pathological condition, the hearing varies according to the individual; deafness is sometimes partial, and is confined to noises and isolated sounds, as though some notes were wanting in the acoustic piano; at other times it becomes generalized, and extends to all noises and sounds indistinctly. In these conditions it is evident that an acoumetre of a single

sound would not suffice; the examination would not be complete without the aid of different acoumetres, or of an apparatus combining different acoumetric elements, as, for example, noises and sounds of different pitch and intensity, which could be isolated or combined according to the wish of the surgeon.

An apparatus was described which combined in a measure these qualities. But M. Delstanche was of the opinion that, until the human voice can be imitated, the examination by the voice must be the indispensable complement of artificial acoumetry.

2. The metre should be the unit of measure of the distance. If the acoumetre should not be heard at a distance, the methodic use of a tuning-fork would give an appreciation, more or less exact, of the degree of hearing.

3. Several ways of registering the hearing have been proposed, but for precision and conciseness none equal the short method now in usage for indicating the frequency of the pulse, of the respiration, and of the temperature of the body. The words watch, quality, voice, right, and left, should be represented by their initials; the distance a watch may be heard by a normal ear, as well as the distance it is heard by the affected ear, should be represented in metres and centimetres.

PART II.

Pathology and Therapeutics.[1]

By CLARENCE J. BLAKE, M. D., Boston.

One hundred and four out of the two hundred and fifty-eight pages of the work of Prof. Bernstein are devoted to sound and hearing. The work, as a whole, is more thorough, and at the same time better suited to the comprehension of the general reader, than are most of the rapidly multiplying books of this class. It is also clearly printed and well illustrated.

[1] In consequence of the illness of Dr. Bertolet, that part of the Report on Otology which relates to Pathology and Therapeutics has been written by Dr. Clarence J. Blake.

of Prof. Coccius on the examination of the eye in polarized light, Drs. Hagen and Stimmel have applied the same method of examination to the ear. The apparatus employed for the purpose consisted of a plain mirror of 13‴ Par. diameter, having a central opening of 3‴ Par. diameter, placed between two Nicol's prisms, each of which, surrounded by cork, was contained in a brass case. The mirror was surrounded by a metal ring having joints at two opposite points, one of which united the mirror with the metal case of the large Nicol prism, and allowed the mirror to be placed at various angles to the large prism. The opposite joint united the mirror to the smaller metal case of the second prism which was placed behind it. The case was set obliquely from left to right in such a position that the smaller prism, with each change in position of the mirror, could be placed vertically to the central opening of the latter. The smaller prism, furthermore, was movable in its metal case, so that, during examination, its plane of polarization could be placed at right angles to the plane of polarization of the larger prism. The authors also found it of advantage to add a ball-and-socket joint at the lower portion of the ring holding the mirror for attachment of a twelve-inch convex lens. By placing this lens over the face of the mirror, the latter was converted into a concave mirror of six inches focus, and, by placing the lens behind the mirror, it served to enlarge the picture, while, in order to examine with the mirror alone, it was only necessary to turn the lens downward. The strong illumination necessary for this method of examination was furnished by a Tobold lamp. The lamp was placed at the left of the observer at the height of the ear under examination, and in such position that the column of light passed close to the ear at right angles to the long axis of the meatus. An ordinary speculum was placed in the ear and held by an assistant. With the left hand, the larger prism was placed at a distance of about half an inch from the opening of the Tobold lamp, while the right hand seized the smaller prism placed behind the mirror, and set the latter at an angle of about 45° to the larger prism. The instrument was held nearly horizontal, so that the light from the lamp, passing through the larger prism

to a larger application of this means of illumination than that of a simple experimental test.

In the otological section of the Naturforscher-Versammlung in Gratz, Kessel, after reviewing the various means employed for determining the degree of hearing-power, describes a new instrument which he has constructed for this purpose. This consists of a series of metal tongues set in vibration by means of pins arranged upon a metal barrel, after the fashion of a music-box. The tongues give the tones of the C scale for six octaves, the compass of the instrument may be easily increased to eight octaves; aside from the musical tones, noises may be reproduced by setting several of the tongues in different octaves in vibration at the same time. The barrel is turned by a handle, on which is an index traveling over a dial-plate and indicating the pitch of the tone produced. The atmospheric conduction of the sound is insured by means of a rubber tube passing into the interior of the apparatus, surrounded by non-conductors and inclosed within a box, so that, except through the tube, no sound can be heard even at a slight distance. The bone conduction is determined by means of a metal rod, one end of which is attached to the tongue-plate, the other being brought in contact with the mastoid process. As with this arrangement, in addition, the air in the external ear can be alternately rarefied and condensed, and the tension of the membrana tympani and the intra-labyrinthine correspondingly varied, it is possible to determine under what conditions the test-sound is best heard.

The apparatus further shows that, when the same tone is heard in differing degrees of intensity in the two ears, it is heard apparently only in the ear subjected to the louder tone; as, for instance, if the right ear is brought so near the instrument as to perceive the tone plainly, and the conducting tube is then placed in the left ear, the tone is heard apparently in the left ear only. Dr. Kessel spoke also of the possible bearing which this experiment might have in explaining the determination of the direction of sound.

The requirements which should be met by an instrument for testing the hearing, and which it has been the author's

endeavor to compass in the instrument described, he classifies as follows:

1. The instrument should include in regular scale as large a number of tones as possible, at least those comprised within the limits of the scale of the human voice.

2. The intensity of the tones must be uniform.

3. It must be so constructed as to permit application of the test to one ear alone, both as regards atmospheric and bone conduction.

4. The intensity of the tones should approximate that of vocal sounds in speech.

Dr. Knapp proposes a new use of the tuning-fork in cases of one-sided deafness, which, with the explanation of its advantages, may be best given in the author's own words: "If a vibrating tuning-fork is moved up and down, before a healthy ear, its sound appears enforced as often as the instrument passes the level of the external auditory canal. If we, however, tightly close the ear before which the fork is moved, the sound appears no longer periodically louder, but uniform, being perceived mainly by the other ear. If the closure of the one ear is not complete, the periodic enforcement is still perceptible, though less marked. If a vibrating tuning-fork is moved up and down before a totally deaf ear, the sound of the tuning-fork invariably appears uniform."

The waves of sound in this case travel in circuitous roads around the head to the membrana tympani of the healthy ear, never impinging on it in a direct way, which in the previous experiment produced the periodic enforcement of sound. Another method of detecting one-sided deafness, proposed by the author, consists in the use of the pneumatic otoscope of Siegle. When this instrument is applied to the healthy ear, the movements of the membrana tympani are distinctly heard as a sound at a low pitch. Patients hearing well with one ear, but being deaf in the other, hear the difference readily, the healthy ear receiving a marked sensation of sound, the deaf ear no sensation of sound at all.

A new method for inflation of the middle ear, recommended by Gruber, consists in a modification, or rather combination, of the use of the ordinary air-douche and the Val-

salvan experiment; the object being, where it is desirable, to dispense with the use of the catheter to close the upper portion of the pharyngeal cavity from below, and produce a pressure in the naso-pharyngeal space which shall extend to the middle ear. This may be accomplished by substituting for the act of swallowing the intonation of certain syllables or consonants, which is accompanied by forcible elevation of the posterior portion of the tongue pressing the soft palate upward and backward against the posterior pharyngeal wall.

This movement is most pronounced on sounding the consonant *k* without the accompanying vowel-sound. Simultaneously with the sounding of *k*, or, better still, *hk* by the patient, air is forced into the nostril by means of the balloon in the usual manner. By interposition of a vowel-sound between the *h* and *k*, closure of the naso-pharyngeal space is more effectual, and by interposing *a*, *e*, *i*, *o*, and *u*, in succession, as, for instance, *hack*, *heck*, *hick*, *hock*, *huck*, the backward pressure of the tongue is effected in a regularly-increasing ratio. By the use of these syllables a measure of the degree of pressure is therefore obtained, and, by inclination of the patient's head to one side or the other, the air is forced into the ear which is uppermost.

Kutscharianz presents the results of the examinations of cases of inflammation of the middle ear in three hundred infants of various ages. After considering the normal condition of the middle ear in the fœtus and new-born infant, the author proceeds to an examination of the changes which occur in different portions of the middle ear in case of inflammation. At the fourth month of intra-uterine life, the middle ear consists simply of a cavity containing three folds, perfectly transparent and rich in blood-vessels, the largest of which is described by Von Tröltsch, surrounding a very small, irregular cavity in which is a clear aqueous and slightly tenacious fluid. The histological structure is not the same in all of these folds, the larger possessing cylinder and the two other pavement epithelium.

At the fifth month there is but little change, the folds are diminished, and the space is somewhat larger. At the end of the sixth month (two cases), and at the end of the seventh

2. Intense catarrhal inflammation, considerable swelling of the mucous membrane, and general separation of the epithelium.

3. Purulent inflammation, with ulceration of the mucous membrane.

The author concludes that the differences signalizing these three groups represent simply progressive stages of the same disease, and that a certain part in these inflammatory processes, aside from communication of inflammation from neighboring structures, may be accorded to the entrance of air into the tympanic cavity during respiration.

In a paper published in the *Monatsschrift für Ohrenheilkunde*, in 1868, and in subsequent papers, some of which have appeared quite recently, Wreden has directed the attention of medical jurists to the entrance of air into the middle ear, and the disappearance of the gelatinous substance which fills the tympanic cavity prior and up to the birth of the child. These communications, in which the author claims for this test an equality to, if not an advantage over, the ordinary test by examination of the lungs, have called forth considerable testimony in rebuttal, and among the papers published, both in Germany and England, is an interesting table given by Ogston. Wreden states that the gelatinous substance mentioned disappears within twenty-four hours after birth; that twelve hours' respiration is not sufficient to effect its complete disappearance; and he therefore suggests that the presence of air in this situation might be of importance in a medico-legal point of view, as proving that respiration had taken place.

Ogston, on the other hand, considers that these statements have been made without sufficient grounds, and that they require considerable modification. In support of this opinion he submits the following table of fifteen cases:

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have been recorded since the first paper of Welde in 1855. In all the sixteen cases given, with the exception of that reported by Dr. Cassell (of Glasgow), there was absolute deafness, and in seven of these also facial paralysis.

This table is followed by a discussion concerning the relatively rare occurrence of necrosis as compared with caries, and of the influence which age, sex, and general constitutional condition, may have in this connection.

As immediate cause of the pathological process in the osseous structures of the labyrinth, there existed in all the cases, with the exception of that of Wilde, a purulent inflammation of the middle ear, with periostitis of the petrous portion of the temporal bone of several years' duration. In support of the occurrence of the necrosis of the labyrinth as a more or less isolated affection, the author cites the notes of Von Tröltsch in this connection, namely: the early and complete ossification of the labyrinth, its nourishment by especial non-anastomosing vessels, and, finally, its extraordinary solidity of structure. The frequent coincidence of facial paralysis with necrosis of the labyrinth occurring in seven of the sixteen cases, the author refers to the topographical relations of the outer and superior semicircular canals and cochlea to the Fallopian canal, which would render a necrotic separation of any of these structures, without injury to the canal and facial nerve, out of the question—an opinion which is fully supported by the pathological observations in the cases given.

As an explanation of the existence of a necrosis of the labyrinth without implication of the surrounding spongy bone, the author presents two possibilities, namely: embolism of the internal auditory artery, which probably existed in the case of Wilde, where the necrosis was not preceded by a purulent inflammation of the middle ear; and purulent periostitis of the labyrinth as a result of chronic purulent inflammation of the middle ear, the means of communication being afforded by destruction of the membrana tympani secundaria; numerous *post mortems* in such cases showing the course of the disease, which terminated fatally before complete necrosis of the labyrinth occurred. A further proof of the correctness of this assumption is found in the presence of polypi accompanying

revealed deep-seated granulations. The left ear being tightly stopped, words whispered close to the right ear were distinctly heard. Ordered syringing with salicylic acid (1 : 600). Four days later swelling continued; wet compresses applied for seven days, with relief from pain, tenderness, and swelling. At this time pressure upon the mastoid gave little or no pain, and an examination after thorough syringing revealed in the cartilaginous portion of the auditory canal a hard body, about the size of a pea, of a dirty-grayish color. This was removed with the forceps, and proved to be the upper two-thirds of the necrosed cochlea. Tests for hearing now gave the following results: With the left ear tightly stopped, whispered words were heard as before; but on also closing the right ear, the whisper was heard with equal distinctness. Tests with König's rods gave the same result. The tests for bone conduction were especially noteworthy. The large tuning-forks C′ C and contra A applied to the forehead were heard only in the unaffected ear; applied to the vertex, however, apparently equally well in both ears. The large C fork being applied to the right mastoid, the patient was uncertain as to whether the sound was heard only on the right or also on the left. The butt of the fork being applied to the right meatus, the vibration was felt only.

Nine days later, the meatus was but slightly swollen, granulations and discharge had nearly disappeared, the opening in the anterior portion of the membrana tympani was plainly visible, the headache and vertigo had entirely disappeared, and the patient passed from observation. Four months later his condition remained the same, and there had been no recurrence of the otorrhœa. This case is interesting from the original cause of the trouble and the later occurrence of more serious disease, the comparative immunity of the patient from the graver symptoms which might have been expected, and the progress of the ultimate necrosis to a favorable result. It demands further consideration also from the results of the tests with regard to the hearing, upon which Prof. Lucæ lays particular stress. The apparent perceptive power remaining to the affected ear is in itself a sufficient commentary upon the necessity for careful tests in compara-

remedy is, as always, the knife. The same rule with regard to the early use of the knife holds good in these cases as in those where the superficial periostitis follows an acute inflammation of the middle ear.

The following cases are cited in illustration: A shepherd, forty years of age, was attacked, after exposure, with severe pain, swelling, redness, and tenderness above and behind the right ear; the application of eight leeches did not diminish these symptoms, and, on the following day, a long, deep incision was made over the mastoid. The pain was almost immediately relieved, the patient slept well, and made a good and speedy recovery.

A woman, forty years of age, after exposure in the open air with the head uncovered, had severe pain in the left side of the head, which finally became confined to the region of the mastoid; the hearing being somewhat diminished, the patient was first treated by the family physician for a supposed ear-disease.

The author being called in consultation, found the region behind the ear red, swollen, and tender; with exception of a slight swelling of its posterior superior wall, the external auditory canal was normal; the membrana tympani presented no specially abnormal appearance, nor were there signs of deeper-seated trouble. Three days later, after application of poultices in the interim, an incision was made over the mastoid with liberation of a considerable quantity of foul pus and relief from pain, this case also proceeded to a favorable recovery. The third case did not end so fortunately, on account of the refusal of the patient to submit to the incision as proposed by the physician in charge. The symptoms were the same as in the two preceding cases, but the want of an early and free exit for the pus, which finally made an opening for itself, resulted in extensive burrowing of the pus, and finally death, following erysipelatous inflammation.

In this case the patient, a gardener, fifty-six years of age, had driven in an open cart in the winter of 1874 for a mile across the open country with a cold wind and snow blowing upon the back of his head; on the following day severe pain in the head set in, which finally became located behind both ears, to be followed by the symptoms and result stated.

The thesis of Dr. Hartert is devoted to consideration of the subject of exhausting pus or other fluids accumulated in the middle ear—the motive to the investigation being furnished by the article of Prof. Gruber on this subject, in the *Monatsschrift für Ohrenheilkunde* of December, 1874. The following experiments were made:

1. The soft parts having been removed from the head of a recent subject, and the membrana tympani exposed, an opening was made in the tegmen. tympani and the middle ear filled with a carmine solution. A perforation was then made in the posterior segment of the membrana tympani, and the fluid sucked out by means of Gruber's syringe. On further removal of the tegmen. tympani, it was found that the fluid had been wholly exhausted, without injury to the membrana tympani or adjacent parts.

2. The experiment was repeated through an opening in the anterior segment of the membrana tympani, the fluid being wholly removed, even from the depressions in the floor of the posterior portion of the tympanum, without injury. In no case was it possible, however, to push the point of the instrument through the membrana tympani as far as the antrum mastoideum without dislocating the incus. Under the latter circumstance, however, fluid could be sucked from the mastoid cells. When the head was placed in proper position, the carmine solution injected into the mastoid cells from without flowed into the middle ear, and was easily removed. The advantages of this method are considered by the author to be:

1. That patency of the Eustachian tube is rendered unimportant.

2. That the secretion accumulating on the floor of the tympanum, and not affected by the use of the air-douche, is easily and entirely removod.

3. That the danger of forcing secretion into the mastoid cavity is avoided.

Dr. Paulsen presents his experience in the use of carbolic acid in the treatment of purulent inflammation of the middle ear, and, claiming nothing new, gives his observations on the results of its application in the manner which he describes.

The ear to be treated is first carefully cleansed, and dried

with charpie or cotton—cleansing by syringing, unless absolutely necessary, being objectionable, in view of the further treatment, which consists in touching the affected parts thoroughly with cotton tampons dipped in a mixture of carbolic acid and olive-oil, ten parts of the former in one hundred parts of the latter. After the touching, a cotton tampon slightly moistened with the above mixture is introduced and allowed to remain until the following day.

Obstinate and neglected cases of otorrhœa, or those which have resisted other measures, have improved in a few days under his observation and with this application. Cases of otorrhœa accompanied by caries should, of course, be excluded from the list of favorable cases.

Small polypi and remnants of polypi, especially such as are found in the tympanic cavity, where a comparatively small perforation of the membrana tympani makes them difficult of access, are easily and satisfactorily treated in this manner; indeed, the author gives this application the preference over the use of ordinary astringents, and has obtained excellent results after the removal of polypi, where there is a tendency to their renewal. The mixture of carbolic acid and olive-oil in various strengths is also found preferable to its use diluted with water, or the use of the carbolized cotton.

The case reported by Darolles is a sufficient commentary upon itself, and may be quoted as presenting the course of the disease without surgical interference.

A woman, thirty-eight years of age, having caught a severe cold after a rheumatic attack, had severe pain and almost total deafness in the right ear. Three days later there was rupture of the membrana tympani, and with the appearance of a purulent discharge the pain diminished; the deafness, however, continued. Two days later a recurrence of cephalalgia, the discharge diminished and there was tenderness on pressure over the mastoid. On the tenth day complete facial paralysis on the right side, and from this time forward marked fever and obstinate constipation. On the thirteenth day, contraction of the muscles of the neck, pulse 130, temperature 40.8°. On the fifteenth day, opisthotonos, herpetic eruption of the face, on the right side about the lips and angle of the

eye, and on the left side about the centre of the cheek. On the sixteenth day, profuse perspiration, involuntary evacuations, paralysis of the left arm; pupils dilated and reacting slowly, thready pulse, and temperature of 40.8°. In the evening the patient died. The section showed injection of the veins of the pia and dura mater, extensive purulent infiltration of the subarachnoid cellular tissue, especially at the base, and also on the convexity of the right hemisphere. Small insulated collections of pus were also apparent along the course of the blood-vessels on the convexity of the brain; in several places the pia mater was adherent to the gray substance. The outer surface of the petrous bone was intact, the tympanic cavity filled with pus, in which the ossicles floated free; there was a small perforation in the upper portion of the membrana tympani. The mastoid cells were also filled with pus, and the facial nerve, laid bare at the point at which, in the hiatus Fallopii, it makes its second turn, was covered with thick pus; the remaining walls of the tympanic cavity were intact.

The following case, reported by Tournevet, may be added to that above quoted:

A female teacher, forty-three years of age, never robust, and having scrofulous scars in the neck, was attacked, after taking cold, with severe intermittent pains in the right side of the head. These symptoms were followed by perforation of the membrana tympani, purulent otorrhœa, and later by cessation of the discharge, marked chills, and constipation. Three weeks later the cephalalgia diminished coincidently with the occurrence of pain in the left hypochondrium and decided fever; the pupils became dilated, the conjunctiva assumed a yellowish tinge, the tongue became heavily coated, the pulse dicrotic, the temperature rose to 40.2°, and delirium set in. The abdomen became tender, there were marked icterous and involuntary evacuations, the pulse could be barely felt, the temperature fell suddenly to 36°, and the patient died four weeks from the beginning of the attack. The section showed hyperæmia of the dura mater, especially on the right side, pseudo-membranous deposits on the arachnoid, the substance of the brain and ventricles intact. The outer surface of the temporal bone showed no signs of caries, but no

thorough examination was made. The spleen was swollen, and softened with *metastatic abscesses;* the kidneys hyperæmic, and in the right kidney two *metastatic abscesses.* There were also fresh peritonitis and numerous sub-mucous ecchymoses in the intestine.

Dr. Vajda reports an interesting case of syphilitic infection, which, his conclusions being correct, carries its own moral:

A servant-girl, twenty-seven years of age, appeared at the clinic with extensive papules of the mucous membrane of the mouth, and especially of the soft palate, tonsils, and posterior pharyngeal wall. On careful examination with the rhinoscope, the mouth of the left Eustachian tube was seen closed and surrounded by firm infiltration, the surface being opaque, white, and irregular. The cervical lymphatic glands were extensively inflamed. The patient was very deaf, and considered her present trouble due to the repeated use of the catheter, six months previously, for relief from a former deafness. The hymen was intact, and there was no sign of a specific lesion. Ten days later, inunction with oleate of mercury was begun. After thirteen applications, and touching the mouth with nitrate of silver, the local symptoms diminished. The condition of the throat and mouth improved and the hearing increased. The further treatment consisted in simple cleansing of the throat and mouth, and nineteen days later the patient was discharged.

Prof. Moos publishes the result of six sections in cases of patients suffering from aural symptoms who died of ileo-typhus. In all cases there were changes, the result of purulent inflammation of the middle ear, and in addition in the labyrinth an infiltration with lymphoid cells; in each case the utricle saccule ampullæ and lamina spiralis membranacea were affected; exceptionally, the semicircular canals, and the zona ossea. The reviewer of this paper, in the *Monatsschrift für Ohrenheilkunde,* doubts whether the above-mentioned change may be considered specific of this disease, as similar appearances have been discovered after severe otitis media unaccompanying typhus, the same appearance having also been found on examination after death from scarlet fever. The reviewer agrees with Gruber in his opinion that the labyrinth partici-

brana tympani, which the writer enlarged to allow of better escape of the pus. There was neither tenderness nor swelling over the mastoid, but some tenderness below the ear; warm instillations and leeches relieved the pain. Twenty days later, however, the pain returned with great severity, accompanied by delirium; on the following day he became comatose at intervals, with stertorous breathing; the tongue was dry, pupils permanently contracted, and the discharge from the ear had apparently ceased. During the day there were rapidly-recurring remissions and exacerbations of fever. Forty-eight hours later there was paralysis of the left motor oculi, the pupil of the right eye was enlarged, and contracted but slightly under stimulus of light, and the patient died on the afternoon of that day. The autopsy showed a long, fresh coagulum in the longitudinal sinus, the other sinuses containing a large quantity of liquid blood. The subarachnoid space contained a large amount of exudation, the pia mater was exceedingly hyperæmic and infiltrated, and the lateral ventricles filled with a grayish-red flocculent serum. The periosteum of the petrous portion of the left temporal bone was smooth and well adherent, except in the immediate vicinity of the meatus auditorius internus; here the bone was denuded, and surrounded by a narrow zone of infiltrated periosteum; the meatus auditorius internus contained the auditory and facial nerves, imbedded in thick, creamy pus. A section of the petrous bone showed the internal and middle ears to be joined in one common cavity filled with pus; there was also pus in the mastoid cells. A probe could be easily passed from the meatus auditorius internus into the middle ear.

The second case was that of a man forty-five years of age, who had suffered for several years from a chronic catarrh of the naso-pharyngeal space. Following an acute ulcerative inflammation of the throat and a severe cold, the patient had an acute inflammation of the right middle ear, followed by perforation of the membrana tympani and muco-purulent discharge. At this time there was no pain in the ear or head, but tenderness on pressure over the mastoid foramen. After midnight of the day on which this examination was made, he awoke complaining of chill, and had a violent rigor, lasting

over half an hour, followed by high fever, accelerated respiration, and delirium, and, later, vomiting. On the following day the pulse was 120, and small; skin hot, clammy, and sallow, and expression apathetic; eyes widely open and staring, pupils fixed and dilated; constant delirium and stupor, and a discharge from the ear of a sanious fluid of a light chocolate color. The mastoid was neither swollen nor tender, but, below the ear, there was a diffuse, moderately hard tumefaction, following the course of the jugular vein; respiration became accelerated and imperfect, and the patient sank rapidly and died in the afternoon. An autopsy showed the left lateral sinus filled with dark liquid blood, and, in the right lateral sinus, running along the petrous portion of the temporal bone, a grayish-red thrombus, firmly adherent to the wall of the sinus, and traceable into the beginning of the jugular foramen. The jugular vein was filled by a dense, firm clot, presenting the brownish, granular appearance of a clot not recently formed. The mucous membrane of the tympanic cavity was intensely red, that cavity, and also the mastoid cells, being filled with puriform matter. There was general and intense congestion of the right cerebral lobe, and an embolic condition of the meningeal vessels.

Hagen reports the results of his use, for the past nine months, of subcutaneous injections of strychnine in cases of nervous deafness. He finds this treatment of unquestionable value and permanent effect. An aqueous solution of one per cent. is used every third day, and injected under the skin covering the mastoid process. In the cases in question, little or no other treatment was employed. The injections of strychnine seemed to have no effect whatever upon the subjective symptoms.

Charcot having observed in several cases that the attacks which occur during the progress of Ménière's disease were preceded by a loud, whistling, subjective noise, and that, like the aura epileptica, this was the premonitory symptom of the vertigo, loss of coördination of motion, nausea, and vomiting, which quickly followed, was led to attempt the substitution of a similar physiological symptom by means of quinine, thereby aborting the subsequent attack. For several cases

which, according to Revillot, presented the group of symptoms characteristic of the so-called Ménière's disease, Charcot gave from 0.75 to 1.20 gramme of sulphate of quinine daily, continuously for several weeks. The subjective noise resulting from the administration of the quinine was kept up for several weeks at a time, and the remedy was omitted, occasionally, only in case of disturbance of digestion, and then resumed.

In a majority of the cases a decided improvement was effected, and in some, so far as the attacks mentioned were concerned, a complete relief followed. Whether the marked symptom of the disease—the deafness—was also relieved, the paper does not state. In a later number of the same journal, Dr. Barcot gives the results of the administration of quinine in similar cases with equally good effects.

Luys gives the results of careful *post-mortem* examinations in two cases of deaf-mutism of long standing, and finds, in his microscopic sections, ground for the opinion which his paper sets forth, that the intra-cerebral point for the transformation of the sensation of sound lies in the posterior portions of the thalami optici, while the ultimate point of perception is to be found in the posterior region of the cortical substance. In both of the cases examined the posterior portion of the thalamus opticus was of a grayish color, softened, with serous infiltration resembling a colloid substance, and exhibiting a large number of amyloid bodies. The gray substance in the neighborhood of the aqueductus Sylvii was changed in the same manner. The continuations of the nervi acustici in the fourth ventricle were visible in the form of indistinct grayish œdematous fibrils.

The first part of Mr. Field's paper, as read before the Harveian Society, is devoted to a definition of the term tinnitus aurium, to quotations from various authors, ancient and modern, as to its causes and importance as a symptom, and to an enumeration of various remedies, empirical or otherwise, which have been suggested for its relief. "I think," the author says, "the mischief can always be traced to the membrana tympani. We rarely find tinnitus present in cases of perforation from ulceration, and incising the membrane no

9. The more simple operative procedures give the best results.

Dr. Burnett reports three cases, which are of interest, as the tinnitus aurium and flushing of the face were probably the result of a central irritation of the sympathetic:

1. A young woman, twenty-six years of age, who had six years previously a right-facial paralysis of rheumatic origin, and had suffered for three years from deafness and a continuous tinnitus aurium. With excitement or exhaustion there occurred a decided twitching of the facial muscles, accompanied by a decided flushing over the cheeks and neck, and an increase of the tinnitus.

2. A small, spare woman, a farmer's wife, fifty-six years of age, experienced a sudden and excessive tinnitus aurium at the menopausis; this diminished in time, but never entirely ceased. The hearing was not affected, but there was a peculiar vascular congestion or flushing coming on with any considerable excitement or fatigue, attended by an increase in the tinnitus, and extending from the ears simultaneously over each sterno-cleido-mastoid muscle forward toward the thyroid gland, where the blushes of either side coalesced and extended over the chest and mammæ. At the same time a similar blush extended over the nucha and upper part of the dorsum, the rest of the surface being sallow. The tinnitus diminished under the use of strychnia ($\frac{1}{60}$ gr. t. d.) for a month, but returned partially on discontinuance of the drug.

3. A large, strong woman, forty-five years of age, living in a malarial district, and pregnant with her eleventh child, has had an increasing deafness of both ears, with tinnitus, for several years. The membranæ tympani were opaque, and there was a peculiar vascular flush on the left cheek, corresponding to the ear most afflicted with tinnitus, aggravated by exertion, heat, or cold, and coincident with an increase in the tinnitus. This case improved under administration of strychnia ($\frac{1}{45}$ gr. t. d.), and the daily use of the constant electric current for a week.

An interesting case of rupture of the membrana tympani is reported by Mr. Hewetson, and is worthy of notice from the peculiar circumstance of its occurrence:

there was no periostitis, but an inflammation of the subcutaneous tissue, a so-called pseudo-erysipelas. Since he does not mention the circumscribed swelling of the head of the sterno-mastoid muscle, the diagnosis in his cases may have been correct; to the case related by me it does not apply. In this the diagnosis periostitis is furthermore corroborated by the observation that thin pus was liberated only when the knife had penetrated down to the bone.

The intense headache, the fever, and the swelling in the upper part of the sterno-mastoid muscle made me, for a moment, suspect a grave cerebral complication, in particular phlebitis and thrombosis of the cerebral sinuses, so much the more as, according to Griesinger,[1] obstruction of the emissarium in the sigmoid fossa produces a painful œdema, limited to the region of the mastoid process. But, since there was neither induration nor swelling of the jugular vein, and the middle ear was in a healthy condition, I could not long entertain the suspicion of an internal affection.

A remarkable feature of our case, and the disease which it exemplifies, was the independent affection of *both* mastoid regions. I cannot account for this fact, though we know that independent affections of symmetrical organs in different parts of the body are no rarities, yet the connecting link, as far as my knowledge goes, has not yet been discovered, not even in so common and dreaded a disease as sympathetic ophthalmia.

The spontaneous *course* of the periostitis mastoidea seems to result in suppuration and its consequences: abscesses, fistulous canals, etc. Spontaneous resolution has not been observed.

The *prognosis*, if the difficulty be allowed to run its course i. e., with no treatment, is not devoid of great danger, as the fatal case of Voltolini demonstrates. If, however, an early and deep incision removes the tension of the periosteum and liberates the pus, recovery seems to be the constant termination.

The *treatment* may be antiphlogistic as long as the nature

[1] *See* S. Moos, "Klinik der Ohrenkrankheiten," p. 253. Wien, 1866.

of the affection is not plainly pronounced and resolution appears possible, yet, from what we have hitherto observed, we must derive the conclusion *that, the more early a bold and deep incision, down to the bone, is made, the more certain and speedy will be the recovery.* The wound should be kept open, and poultices applied, as long as suppuration is present. I need not speak of the treatment of complications, since it has to be conducted on general principles.

A CASE OF EXOSTOSIS OF THE EXTERNAL AUDITORY MEATUS DRILLED OUT BY THE "DENTAL ENGINE."

By ARTHUR MATHEWSON, M. D., Brooklyn, N. Y.

The following case is presented as worthy of record from the fact of its being one of the very few cases of exostosis of the auditory meatus successfully removed by surgical operation, and because it illustrates a new and, as it seems to me, better method of operation—namely, the application of the "dental engine," or lathe.

The class of cases to which it belongs is not unimportant, for aural exostosis may not only impair the hearing but endanger life. The patient was the one whose previous history is given on page 407 of Dr. Roosa's treatise on "The Diseases of the Ear."

Miss M. M., aged twenty-five, small, delicate, and subject to neuralgic pains, but in fair general health, was put under the influence of ether in March, 1873, for the purpose of thoroughly examining, and, if practicable, removing a tumor blocking up the right external auditory canal. The examination was conducted by Dr. Loring, under whose care she was, assisted by Drs. Roosa and Pardee.

"The tumor arose from the posterior portion of the osseous canal of the right ear, and nearly occluded the passage. There was a minute opening between it and the anterior wall, through which a No. 2 Bowman's probe could be passed into the cavity of the tympanum. The tumor was of bone, and covered by a movable integument, which was red, and very sensitive. On passing the probe into the minute opening that

foot, while the hand-piece, to which the burrs or drills are attached, held like a pen, can be raised or lowered, and turned in any direction desired.

Under the instruction of my friend Dr. William Jarvie, dental surgeon, I experimented with this engine on teeth and bone, so as to get some appreciation of its power, and of the proper degree of pressure in applying it. Dr. Jarvie also ground the burrs figured to a form which seemed best adapted to the work proposed—to use the technical terms, making a square drill out of a fissure burr. The engine was set up under his supervision, and arranged properly with reference to the height and position of the bed on which the patient was to lie during the operation.

FIG. 2.

The operation was performed, May 21, 1876, with the assistance of Drs. Rushmore, Colton, Cornwell, and Jarvie, the latter working the treadle of the engine with which his daily practice had made him familiar. The patient was under the influence of ether. The meatus was illuminated by a mirror on the forehead of the operator. The first step was to remove the integument covering the growth, that it might not clog and impede the action of the drill. This was done by another dental instrument known as the scaler, the skin being circumscribed and scraped off with it. The bony growth was then perforated at several points near its centre with the smallest of the drills, about one and a half mm. in diameter, which penetrated without difficulty, with so slight a pressure, that there was but little danger of its slipping forward and injuring the deeper parts, though the growth was eburnated and excessively hard. The larger drills (two and a half and three mm. in diameter) were next used successively to enlarge the

perforations and run them together, and by lateral pressure to ream out the meatus.

There was so much bleeding that I was obliged, in spite of frequent swabbing with styptic-cotton, to depend much on the probe for guidance in the operation. The excavation was continued cautiously till the largest drill—about three mm. in diameter—passed freely through, with room to spare, and the probe could be carried in the whole length of the meatus. Besides using the styptic-cotton on cotton-holders, the meatus was repeatedly syringed during the operation for the removal of blood and *débris* of soft and bony tissues.

The operation occupied twenty to thirty minutes. No troublesome hæmorrhage followed, and the pain experienced by the patient on recovery from the influence of ether was easily subdued by the warm-water douche and moderate doses of opiates. A purulent discharge from the meatus soon came on, for which a weak solution of sulphate of zinc was used, at first after syringing, and later the parts were touched with solutions of nitrate of silver. For weeks after the operation the meatus was so nearly filled with swollen and granulating soft tissues that nothing could be seen of the membrana tympani, but examinations with the probe showed that a considerable opening in the hard structures existed. Gradually, and with occasional applications of nitrate of silver, these soft, granulating tissues thinned down, till now there is an opening of nearly the full size of the meatus, except at one point where there is a thin remnant of the exostosis projecting from the anterior upper wall of the meatus. The posterior lower part of the membrana tympani can be seen.

All discharge has ceased ; there is no irritation or unpleasant symptoms of any kind, and the hearing has risen to nearly the normal standard.

In connection with the foregoing case, a brief *résumé* of the history of the therapeutics of exostosis of the auditory meatus may not be inappropriate.

Toynbee reports nine cases, one of which was treated by local applications of strong solutions of nitrate of silver frequently repeated for a long period, with the ultimate result of

though smaller than it had been at one time after the operation, and the hearing was very good.

Voltolini has suggested the application of galvano-cautery to the periosteum of exostosis, with the hope of causing it to be thrown off. According to Schwartze's experience, there is danger to the walls of the meatus, from slipping of the galvano-caustic noose from the smooth surface of the growth.

In a note to Aldinger's paper, the editor of the *Archiv* refers to a case of exostosis reported by Hinton, which had been operated on by Clark, of Clifton, England, with the constant galvanic current. He says, briefly, "After two applications of three needles under chloroform, the exostosis came away in mass, and the patient heard again; entirely well." There is no history of the size or shape of the growth, or of its attachment, but it seems hardly probably that such a result could have been attained in a broad-based, eburnated tumor.

In comparison with any of the methods of operation employed in the cases collated, that with the dental engine seems to me the best, as being less tedious, less dangerous, and more effective. That it is less tedious, a few tests of this and any hand-drills in perforating dense bone will demonstrate. It is less dangerous for the reason that, with the rapidly revolving drills, perforations can be quickly made with so slight a pressure that there is little risk of injuring the deeper parts of the ear, or the walls of the meatus, by the slipping so likely to occur in operations with hand-drills, or with hammer and chisel. The instrument is also held between the thumb and fingers in such a way as to interfere to a less degree with the illumination and inspection of the meatus during the operation. The drills and burrs can also be used, not only to perforate with their points, but also to enlarge openings, already made, to any desired extent or direction by lateral pressure with their sides.

Other uses for the dental engine in surgery readily suggest themselves. There is a great variety of burrs, drills, and saws—more than three hundred in all—figured in the manufacturer's catalogue, which can be attached to the engine, and would be of great assistance in operations on bony

TEST-SENTENCES FOR DETERMINING THE HEARING POWER.

By ALFRED H. BUCK, M. D., New York City.

(PRELIMINARY COMMUNICATION.)

There are two tests in common use for estimating the acuteness of a person's hearing. These are the ticking of a watch and spoken or whispered words or sentences. Both of these tests, as is universally admitted, are unsatisfactory in many cases. Thus, for example, the patient may be able to distinguish the ticking of a watch at a distance of several inches, and yet he may have the greatest difficulty in understanding ordinary conversation; on the other hand, he may not be able to distinguish the ticking of a watch at all, but he will readily understand spoken language. Such contradictory results render the watch a very untrustworthy instrument for measuring the hearing.

When a person, who is suffering from deafness, applies to a physician for relief, his principal object is, not merely to regain the power of hearing certain delicate sounds (like the ticking of a watch), or of clearly and accurately distinguishing each individual tone in the musical scale, from the lowest to the highest, but rather to secure an improvement in, or a restoration of, the power to understand spoken language. If the physician, therefore, wishes to watch with some degree of accuracy the effect of his treatment, he must, in some way or other, utilize speech as a means of determining the changes in the acuteness of his patient's hearing. The usual method of doing this has been to ascertain at what distance the patient could hear correctly any arbitrarily chosen words (usually numbers) or sentences repeated by the physician. Those who

have used this test, however, are well aware of the difficulties with which it is surrounded—difficulties which have led many physicians, at least on this side of the Atlantic, to abandon it altogether.

In the first place, it is difficult always to use the voice at the same pitch and with the same intensity on all occasions. This difficulty, though, can be very soon overcome by practice. In the second place, most of our houses are so small that we cannot obtain the necessary amount of space for employing the voice-test in a very accurate manner. In most of our city houses, however, it is possible, in one way or another, to secure an open space of about forty-five feet in length. This length we are compelled to adopt as our normal limit of distinct hearing for ordinary spoken language. While it falls short of the normal limit by a great many feet, we may, nevertheless, assume that, if a patient can distinctly hear language spoken in an ordinary distinct tone of voice at a distance of forty-five feet, his hearing is sufficiently acute for him to dispense with the professional assistance of an aurist. A third difficulty lies in the great differences in words as regards their penetrating power, some being heard easily at a great distance, while others can only be distinguished with difficulty a few feet off. Take, for an example, these very words, "distinguished" and "difficulty," and it is easy to understand how a patient, who can hear such words as "alarm," "mortality," and "adviser," the full length of our assumed normal limit, would, perhaps, not be able to hear these less penetrating ones correctly at a distance of more than fifteen or twenty feet. Hence, if spoken words or sentences are to be employed as a test of the changes in acuteness of hearing, it is desirable that some attempt should be made to group a certain number of sounds (vocal), words, or sentences in classes, all the members of any one group or class being—as nearly as it is possible to make them—equal in value as regards penetrating power. If such a series of tests could be prepared, we would be able, at suitable intervals of time, to subject the acuteness of hearing for spoken language to a test which might be considered as reasonably free from the objections just enumerated. In other words, we should feel that, upon each occasion

TWO CASES OF ACUTE INFLAMMATION OF SCHRAPNELL'S MEMBRANE.

By ALBERT H. BUCK, M. D., New York City.

Case I.—W. C., aged thirty-three, policeman, sought relief March 10, 1874, for a very annoying tinnitus in both ears. No pain; no deafness. Trouble began about two months previously. Hearing distance for watch = R. $\frac{6}{15}$, L. $\frac{6}{15}$. Both tympanic membranes dull, slightly sunken; some redness of Schrapnell's membrane on the left side.

March 14th.—Painted left Schrapnell's membrane with a solution of nitrate of silver, gr. 120, Aq. ℥ 1.

March 16th.—Tinnitus worse in the left ear; constant ringing of bells. There is also some pain in the left ear, though he says it is only slight. Nevertheless, the man has the appearance of a person in suffering; he makes light, I think, of his pain. Hearing distance for watch $\frac{3}{15}$ (three feet). Schrapnell's membrane red and glistening. Through the upper and posterior portion of the membrana tympani, which is still translucent, a circumscribed yellowish region can be made out. It conveys to the eye the impression of some yellowish body projecting downward from the inner side of the axis-band of the hammer. Suspecting the existence of an accumulation of pus, I made an incision into the red tissues of Schrapnell's membrane just above the post-sup. quad. of the M. T., i. e., just above the yellowish region seen through the M. T. A drop of pure, thick pus followed the incision. A second incision into the anterior portion of Schrapnell's membrane, which was also somewhat red, gave escape only to blood.

brane, from which a fistulous track leads inward a variable distance, and at the bottom of which the probe usually encounters denuded bone. Sometimes this opening is so extensive that the neck and head of the hammer lie exposed to view. The peculiarity of these cases, however, lies in the fact that the membrana tympani is still entire, and, in many cases, not adherent to the inner wall of the tympanum. Inflation, too, either by Politzer's method or by means of the catheter, reveals the fact that the cavity of the tympanum contains no fluid, and has no communication with the fistulous cavity. In other words, the trouble is a chronic caries of a limited region of bone in the immediate vicinity of the middle ear; but it differs from all the more common forms of caries encountered in this region in the fact that the pus and detritus thrown off from the diseased part do not escape by way of the tympanum, but through a sinus which, though appearing to lead directly into the middle ear, has no communication whatever with this cavity.

If I am not mistaken, it has been customary to explain these cases on the supposition that originally there was an inflammation of the entire middle ear, with a perforation in Schrapnell's membrane, but that gradually the inflammatory process became restricted to the tissues occupying the upper and posterior portion of the cavity, the wall of separation formed by the healing process being so perfect as to entirely prevent any of the inflammatory products from entering the middle ear. In a word, these cases have been looked upon as cases of an imperfectly healed purulent inflammation of the middle ear.

The two cases I have just reported suggest the idea that the pathology of this class of cases may be a different one; that is, that at the outset the inflammation may have been restricted to the soft parts constituting, and lying near to, the posterior half of Schrapnell's membrane. As the descriptions of these two cases show, such a circumscribed inflammation of Schrapnell's membrane does sometimes occur, and, such being the fact, is it not more natural to explain these cases of fistulous opening in Schrapnell's membrane as *ab initio* cases of

Inflation by Politzer's method exerted no influence whatever on the contents of the abscess. After the immediate pain of the incisions had subsided, the patient expressed himself as feeling greatly relieved in the condition of his head.

March 18th.—No discharge has occurred since operation.

March 23d.—Very little tinnitus remains in the left ear.

Case II.—Mrs. O., aged *circa* thirty; healthy. On the 18th of April, 1876, she began to suffer from pain in the right ear. Her physician examined the ear, and, finding it filled with a plug of cerumen, he removed it by syringing. During the following three days she continued to suffer from pain in the ear, the pain not being constant, but coming on in paroxysms, with intervals—which sometimes lasted for several hours—of complete freedom from pain. The pain, however, when it came, was of very great severity, especially on the 21st of April, the day on which I saw her. At this time I found the meatus in a normal condition; the M. T. was beginning to be slightly œdematous (like polished steel when breathed upon), but not visibly reddened; Schrapnell's membrane red and somewhat swollen, especially posteriorly, but without anything like "painting." Hearing distance for watch $\frac{1}{15}$ (twelve inches).

A free incision (*circa* four mm. in length) into posterior portion of Schrapnell's membrane caused quite a large drop of pure, thick pus to almost gush out through the opening.

I did not see the case again, but the physician reported that the operation gave complete relief, and that very little, if any, discharge made its appearance afterward.

Remarks.—As a rule, it is neither a safe nor a very profitable thing to report and draw conclusions from only two cases of a disease. In the present instance, however, I think it is better not to wait for the opportunity of seeing other cases of the same nature—an opportunity which may not present itself in years—but rather to call the attention of my colleagues to the subject at once, in the hope that in this way a sufficient number of cases may be the more rapidly accumulated.

Every aurist sees a certain number of cases of otorrhœa in which the only demonstrable lesion of any importance is an ulcerated opening in the posterior half of Schrapnell's mem-

circumscribed inflammation?[1] Further observations of such cases will undoubtedly furnish us, in due time, with a satisfactory explanation of their pathology.

Finally, let me draw attention briefly to the question of diagnosis in these acute forms of inflammation of Schrapnell's membrane.

In the first case, I interpreted the yellowish appearance seen through the membrana tympani as indicating a swelling (due to the presence of an abscess) of the inner side of Schrapnell's membrane. The patient, it is true, did not complain of serious pain, but his haggard countenance and excited state of mind (repeatedly asking me if the trouble were not in his brain instead of in the ear) showed clearly that some serious disease was present. At the same time, I was not a little surprised to see pus follow the incision.

In the second case, owing to the knowledge gained in the first case, I felt quite confident that pus had either already formed, or would speedily form, in Schrapnell's membrane, unless the knife were used.

The points which favor the diagnosis of an abscess in Schrapnell's membrane—so far, at least, as can be gathered from my two cases—are the following:

1. The well-marked redness of Schrapnell's membrane, especially posteriorly.
2. The absence of any evidence of active inflammation of the middle ear proper.
3. The severity of the pain in the ear.
4. The slight degree of impairment of the hearing.

In regard to the question of differential diagnosis, there are but two troubles with which the one under discussion

[1] In this connection, we should not forget that, in the two cases just narrated, the local irritation of Schrapnell's membrane—in the one case by the application of a strong solution of nitrate of silver, in the other by the pressure very probably exerted on these parts by the mass of cerumen—may have determined the localization of the inflammation in this particular region. This, I must confess, is a strong point against the view here propounded. On the other hand, if the inflammation had followed directly upon "catching cold," or as a sequela of one of the exanthematous diseases, we might with much greater assurance put forward this view as the correct one.

might be confounded, namely, an acute inflammation of the middle ear proper, and an acute inflammation of the antrum mastoideum and adjoining cells without decided participation of the middle ear proper. In the former affection, the appearance of the membrana tympani tells the story pretty clearly, while in the latter the pain is referred to the mastoid region more particularly, and there is apt to be tenderness on pressure, and, perhaps, even œdema of the skin covering the process.

The diagnosis once established, there can be no hesitation in regard to what is the proper treatment to pursue. An incision through the posterior half of Schrapnell's membrane, close to the insertion of the membrana tympani, is the only thing we can do to relieve the patient's suffering, and prevent (in all probability) subsequent chronic disease of an annoying and even dangerous character.

the Eustachian tube. I believe that this view of the development of these parts is incorrect, and shall in this paper state what I believe to be the fact on this point.

Von Baer gave an account of the development of the primary optic vesicle that has held its own against the view of Huschke; in regard to what we now call the secondary vesicle, Von Baer made a mistake that misled many after him; he located the vitreous between the two layers of the retina formed by the folding in of the primary vesicle, or, what amounts to the same thing, in the primary optic vesicle.

In 1830 Huschke described the involution of the lens Remak confirmed his observations, and soon after Vogt and Remak described the manner of growth of the lens fibres from the epithelium of the lens vesicle. Schultze, Müller, Babuchin, Iwanoff, Zernoff, Kessler, Lieberkuhn, and others, have done much in clearing up special points. Prof. Arnold's last contribution, "Beiträge zur Entwickelungsgeschichte des Auges," contains one of the most correct and practical accounts that we possess; he follows the process in one species and in an almost complete series of embryos of different ages.

The eye is first formed by a protuberance from the brain, which consists of a hollow stem—the optic nerve—the expanded extremity of which forms a globe, the primary eye vesicle; soon the lens is formed by a thickening and involution of the integument over the vesicle; this process—the involution of the lens—turns the anterior half of the primary vesicle inward; the cavity thus formed is the secondary optic vesicle. The succeeding stages will be described in detail, and a comparison made with the corresponding stage of development of the labyrinth.

Embryo Pig, ⅜ of an Inch long: Ear.—The otic vesicle is ovoid, the recessus labyrinthi forms a wide-mouthed diverticulum from its upper extremity, the apex of the recessus is surrounded by a thick network of blood-vessels, the commencement of the choroid plexus; at this time the blood-corpuscles vary much in size, and many have a large, round, granular nucleus; sections of the blood-vessels show the nuclei of the cells which formed their walls.

Eye.—The eye at this time is a much more complicated

structure: the primary optic vesicle has been doubled in by the inversion of the lens, which at this time is a mere depression of the integument; the cylinder cells in the bottom of this depression are longer than those on its side and on the neighboring surface; the depression itself is filled by a collection of delicate, round, slightly granular cells, which in all probability hold the same relation to the cylindrical cells that the epithelial scales hold to the rete malpighii. I have not been able to find the longitudinally striated layers described by Arnold as covering these round cells; accordingly my sections agree exactly in appearance with Fig. 2, plate xxi., in the 11th vol., 3d part, of the *Archiv für Mikroskopische Anatomie*, where Mihalkovics states that he also is unable to find the layer in question. When the epithelium folds in to form the lens, it carries with it a layer of the connective tissue upon which it rests; this now appears as a hyaline substance in which blood-vessels are rapidly developing; blood-corpuscles are also formed in the layer of tissue bounding the vesicle on the outside. It is interesting to know that blood-corpuscles are seen in this location before a trace of pigment is seen in the retina.

Embryo Pig, $\frac{11}{32}$ of an Inch long: Ear.—The otic vesicle is considerably changed in appearance; it looks now as if compressed from without inward and then flexed, so that it forms a curve with the convexity outward; the apex of this curve is the point at which the horizontal semicircular canal buds out; from the superior extremity there are now two diverticula, one the recessus, and one for the vertical semicircular canals; a slight depression on the inner wall marks the position of the future sacculus rotundus; the epithelium is much thicker at the inferior portion of the sac where the cochlea is budding out and thinnest over the vertical semicircular canal. This form of the labyrinth is evidently intermediate to those illustrated in Figs. 8 and 9, plate 1, by Böttcher, in his "Entwickelung und Bau der Gehörlabyrinth," yet the embryo whose labyrinth I have described was shorter than that from which Fig. 8 was drawn. Although Böttcher used fœtal sheep, I think that the difference results from the difficulty, referred

tance to the anterior wall; naturally the central fibres are the longest; the fibres on the surface are slightly curved, concavity outward; the central fibres are straight; the fibres increase in size from their centre to their anterior extremity, where they present on cross-sections a perfectly amorphous interior and a sharply defined contour; between the termination of the fibres and the anterior surface of the lens is a space filled with protoplasm; it is natural to associate this appearance with the disappearance of the delicate cells that formed the contents of the lens before the fibres commenced their growth, but I know of no direct proof that there is any connection of the two processes. In the vitreous a large number of blood-vessels are seen which ramify upon the surface of the lens; they enter with the optic nerve and through the embryonic fissure; just anterior to the fissure is a cluster of blood-vessels.

Pig Embryo, $\frac{11}{16}$ of an Inch long: Ear.—The semicircular canals and cochlea have progressed considerably in their development; the indentation for the sacculus is deeper, but the general appearance of these parts is not strikingly different from that in the embryo $\frac{9}{16}$ of an inch long; the connective tissue surrounding the labyrinth has been transformed into cartilage. In sections of the head at this age, I have seen appearances that would indicate that the cochlear and vestibular branches of the auditory nerve arise from separate roots.

Eye.—The lens-fibres have nearly reached the anterior surface; the epithelium of the lens is thinner in front, but increases gradually in thickness to a point about half-way between the equator and posterior pole, where the epithelial cells pass over into lens-fibres; a small triangular cavity exists at the posterior pole; this space is filled with large, round globules that have no structural characteristics; the layer of nerve-cells has commenced forming in the retina; anteriorly, where the posterior layer of the retina passes over into the anterior layer, the character of the cells composing the retina is changed; the body of the cell is here long and narrow; in the other parts of the retina the cells consist of oval nuclei and delicate processes; the pigment is very abundant; the

layer of connective tissue at the site of the cornea has increased in thickness, and the membrana capsulo pupillaris is in the position occupied later by Descemet's membrane; the lids have commenced forming.

Pig Embryo, ⅞ of an Inch long: Ear.—The cartilaginous labyrinth is clearly defined; the recessus labyrinthi now lies in the connective tissue forming the dura mater, excepting its vestibular end, which lies in cartilage; the dura mater fills out the angle formed by the junction of the temporal and petrous cartilages; in the apex of this angle a sinus has formed; not far from it is seen the extremity of the recessus; the semicircular canals have a hardly perceptible lumen; the cochlea has one and one-half turns; its epithelium is thick and is easily detached from the surface beneath; the greater epithelial protuberance has commenced forming.

Eye.—Here a marked change is seen; the sclerotic and cornea can be easily distinguished; the cornea is considerably thicker than the sclerotic, and the corneal corpuscles are seen; they appear to be the developed nuclei of connective-tissue cells, some of which are seen among the corpuscles unchanged; the membrana capsulo pupillaris adheres to the posterior surface of the cornea; the formation of the ciliary body has begun; it is composed of connective tissue from the neighborhood of the corneo-scleral junction, of transformed cells of the retina, and of tissue from the vitreous; its apex is drawn out into a thin hyaline structure that covers the surface of the lens; the lens is solid; in the retina there is an evident stratification; when the two layers of the retina are separated, the limitans goes with the internal layer, and a hyaline substance is discovered that adheres partly to the limitans and partly to the outer layer.

Meatus Externus, Drum, and Eustachian Tube.—The idea that the Eustachian tube, tympanum, and external meatus are formed from the first branchial cleft, was first published in the *Isis* by Huschke in 1827. Von Baer did not coincide with this view. In 1828 he described the development of these parts more in accordance with what seems to me to be the truth. Huschke's view as to the development of the otic vesicle was soon proven to be correct, and Von Baer's error on

this point no doubt weakened his authority on the one in question. Von Baer did not follow the development of the ear very closely, as he himself states on page 146, vol. i., of his "Entwickelungsgeschichte der Thiere," so that his descriptions lacked the necessary accuracy. Huschke's statements have been accepted by every writer on development with whom I am acquainted. Kölliker, in his deservedly popular "Entwickelungsgeschichte," gives the history as follows: "The first branchial cleft, which is fully open in the human embryo at the fourth week, closes in the fifth week, not, however, in its whole length, as do the other clefts, but so that at both sides of the place of closure, which lies near the outer opening, the beginning and the inner end of the canal remain open; these parts are nothing other than the sites of the meatus auditorius on the one side and the Eustachian tube and the tympanum on the other."

The history of the development of these parts, as I have found it, is as follows: The Eustachian tube is an involution of the mucous membrane of the pharynx; it is not in any way the remains of a branchial fissure, but lies in the tissue in which the base of the skull is forming; it grows in length as the branchial fissures close. When the cartilaginous cochlea is first formed, the Eustachian tube lies under it, and follows its outline to the site of the middle ear, which at an earlier date is principally indicated by the ganglion of the facial nerve.

The meatus externus is formed as follows: The first branchial cleft in an embryo $\frac{5}{8}$ of an inch long is very narrow; in its middle portion there is a slight protuberance of the second branchial arch that breaks the otherwise straight course of the fissure. In an embryo $\frac{6}{8}$ of an inch long, the cleft is closed, excepting that, at the point at which the projection of the second arch was situated, there is a shallow depression remaining; this point corresponds nearly to the middle section of the cleft. The process of closure is interesting: the ends of the inferior maxillary process of the first branchial arch grow together very early—they are joined in an embryo $\frac{7}{8}$ of an inch long—soon after, the second arch closes in front, and at the same time fuses with the first arch in its ventral portion, so

that the first branchial cleft is obliterated as far as the inner end is concerned; as a result of this process the buccal cavity is closed in. The outer end of the first fissure, seen in profile views of the embryo, has also closed down to the furrow mentioned above, which is situated on the side of the embryo just above the blunt angle formed by the junction of its lateral and ventral surfaces; this depression is a shallow one, and does not represent the whole depth of the fissure; the first and second arches are united beneath it; bisect an embryo $\frac{5}{8}$ of an inch long in the antero-posterior median plane, separate the walls of the buccal cavity, and the site of the depression is seen to be occluded by a thin, translucent layer of tissue. Now, the projection of the second branchial arch increases in bulk and becomes more pointed, but the thickness of the fold makes the point appear rather blunt at first; the tissue of the first arch on the opposite side of the depression forms a slight ridge. When this point is reached (in an embryo $\frac{3}{4}$ of an inch long, or little less), the meatus externus commences as a burrow into the tissue of the first branchial arch—or rather into tissue that did compose the arch, for the arch has now disappeared. In an embryo $\frac{7}{8}$ of an inch long, the meatus is very apparent, the pointed protuberance above spoken of is much thinner, and is now easily recognizable as the auricle; it points forward; the meatus is not only deeper, but, as a proof that the process of its formation is an active process, its termination is much nearer the Eustachian tube. A section of the embryo at this stage shows that the meatus has extended so deeply that its inner extremity lies under the outer portion of the Eustachian tube—in fact, is almost in contact with the tube; the portion of connective tissue lying between meatus and Eustachian tube is the membrana propria of the drum, the meatus forming its dermoid or inferior surface, the Eustachian tube its superior or mucous surface. In the connective tissue above, and posterior to the location of the drum, the ossicles have commenced forming; the stapes does not, as most authors state, form later than the other ossicles, but, no doubt, it appears later in the tympanum. Its first appearance seems to be rather in the vestibule than in the tympanum, not free in its cavity, for it is connected with its cartilaginous walls.

This position of the stapes is caused by a gradual absorption of the cartilaginous wall of the vestibule at this place, caused apparently by the growth of the stapes. I am not aware that this explanation of the formation of the oval window has ever been given; it is, at least, as satisfactory as the ordinary statement, that the "oval window is a portion of the vestibular wall in which ossification did not take place."

According to this view of the development of the parts in question, the concha is the only opening left in the closure of the first branchial fissure, and the furrow bounding the lower border of the under jaw indicates the course and line of closure of the cleft.

I have found it utterly impossible to obtain a satisfactory idea of this part of the history of development, as it has been heretofore presented. In what manner were the dermoid and mucous surface of the drum formed? How did the drum obtain the horizontal position which characterizes it in the embryo? How did the Eustachian tube reach its position at the base of the skull in parts not at all concerned with the branchial fissures? These and many other questions it left unanswered.

The congenital malformations of this part are also but so many puzzles, considered in the light of the ideas that have hitherto prevailed as to its development; for, if those ideas were true (since the most common cause of such malformations is arrest of development), we should expect to find absence of the drum, a meatus or Eustachian tube with fissures in their walls, as the most common congenital defects. Instead of this, occlusion of the meatus is the most common malformation; this, according to the views which we present, is due, as it should be, to the most common cause, viz., arrest of development.

It would be out of place to speak of the phylogenetic relations of the facts here presented, although they are interesting.

To recapitulate: The Eustachian tube is an involution of the pharyngeal mucous membrane; the meatus is an involution of the integument; the drum is formed by the Eustachian tube overlapping the extremity of the meatus.

PERFORATION OF THE MEMBRANA TYMPANI, WITH SCARCELY A SYMPTOM OF DISEASE.

By Dr. E. L. HOLMES, Chicago.

Mrs. H., thirty-nine years of age, had enjoyed excellent health till the spring of 1871. In early childhood she suffered from some disease of the left ear, which resulted in a permanent perforation of the membrana tympani without otorrhœa. With this ear the patient has always been able to hear a watch at the distance of two inches.

Quite early in 1871 the patient began to suffer from slight attacks of asthma and bronchitis. Between the spasms there were constant sibilant and musical *râles* in the lungs, changing rapidly in intensity and locality. Late in the summer the patient experienced a very slight itching in the right ear. I was several times consulted for this symptom, but could never detect the slightest appearance of disease. The external meatus and membrana tympani were absolutely free from redness, or any apparent anomaly. Air passed easily into the middle ear; the hearing was normal, as tested by the watch and voice. There was no tinnitus.

At the end of a few weeks the patient suddenly observed, with absolutely no premonitory symptom, that air passed through the membrana tympani. An examination even then revealed no symptom of disease. There was, however, near the periphery of the lower portion of the posterior half of the membrana tympani, a dark-brown deposit no larger than the head of a pin, which was evidently the seat of the perforation. The patient could force air through the opening with

ON GASEOUS INTERCHANGE IN THE TYMPANIC CAVITY; PHYSIOLOGICAL CONSIDERATIONS AND THERAPEUTIC APPLICATIONS.

By A. LOEWENBERG, M. D., Paris.

Physiological Considerations. — Otology considers it a fundamental fact that, in cases of obstructed Eustachian tube, the air contained in the drum is absorbed to a greater or less extent. Thus are explained the ordinary consequences of occlusion of this canal: sinking inward of drum-head; increased pressure on labyrinthian fluid by the chain of ossicles; diminution of hearing, heaviness, etc. It is needless quoting examples of this assertion; all special treatises and monographs abound in applications of this otological dogma.

The palliative treatment necessarily corresponds to this interpretation of the causes of those symptoms; the "absorbed" air is restored by inflating other air by the catheter, or by Politzer's method, until the middle ear possesses again the normal quantity of air.

To it, long since, this interpretation suggested to me considerable doubt, because it seemed to me to neglect the important question of what really happened in the drum after occlusion of the Eustachian tube. Proofs seemed to me entirely absent for this hypothesis, and I thought them the more desirable, as a prior physical as well as physiological consideration rendered such a phenomenon very improbable. The question, therefore, was, What are the real consequences of obstruction of the Eustachian tube?

Direct experimentation offered the greatest difficulties, not

panic cavity, caused by this "quasi-respiratory" act (as I shall call it, to be brief), in order to prevent or delay thereby the diminution of hearing caused by this deperdition in case of obstructed Eustachian tube. I therefore substituted for the commonly-used atmospheric air other gas less subject to diminution by "quasi-respiration."

Reflection suggested to me the idea of inflating a gaseous mixture almost natural, as it were, and little subject to diminution by "quasi-respiration," because its composition just equals that of the final result of gaseous interchange, that is to say, it is composed of Az, very little O (if any), and a large quantity of Co2, the whole warmed to a degree approaching that of the body, and saturated with vapor of water corresponding to this temperature.

This mixture necessarily must behave quite indifferently toward the gas of the blood; the same as air behaves, according to Pflüger and Wolffberg, when it has undergone the respiratory interchange. And what combination could furnish this compound more exactly and easily than the *lung?*

I therefore employ plainly *expired air* for the inflation. A very deep inspiration, followed by keeping the breath as long as possible, and making a strong expiration, would furnish a compound very similar to the one I wish to obtain; but I found it both more convenient and more sure to complete the gaseous interchange by submitting the same quantity of air to several alternative inspirations and expirations. I make the patient breathe into a bag made of thin rubber, or a bladder, provided with a cock, to which I adapt a piece of rubber tubing; the free end of this latter is introduced into the mouth of the patient, who shuts his nose with the fingers, and inspires and expires alternatively from and into the bag. (Each patient, of course, has his own piece of tubing—a thing I have adopted, a long time ago, for Politzer's method, too, and I even design by a letter the end to be introduced into the nose—for cleanness.) The bag, at the beginning, can be empty or full; in the former case, the patient begins, of course, with an expiration; in the latter, with an inspiration.

taining a solution of caustic potash. I collect the gas in a bag of rather thick India-rubber, or a bladder, ending in a cock, to which I adapt a piece of rubber tubing. When it is to be employed, I introduce into the free end of the tubing the nozzle of an air-bag, previously emptied to the utmost by compression. I open the cock, and the bag fills with H by dilating itself. I then use it as we do with common air, and I fill and empty it several times through the catheter, or by means of Politzer's method. I attend to giving the head of the patient an inclination toward the side opposite the affected ear, in order to put the Eustachian tube in a vertical direction, which favors the entering of H; for thus it mounts not only by the impulsion of the hand, which compresses the bag, but also by its own ascensional power, in consequence of the small specific weight of H.

It is necessary always to use only recently-prepared H, as the endosmotic power of the gas is so considerable that it is impossible to conserve it in a bag or bladder.

It is not useless to advise the danger of approaching a flame in operating with H, for a mixture of H and air would explode with the utmost violence.

All who have had occasion to treat a great number of otological patients will agree with me in considering inflation of air as being at the present day the most invaluable and most generally useful remedy of otology, as well as the most inoffensive. In an immense number of cases we use it to furnish to the middle ear the quantity of air wanted for the functions of drum-head and ossicles, as well as for preserving the labyrinth from excessive pressure caused by sinking inward of this membrane, and thereby of the ossicles. Inflation often restores hearing with wonderful instantaneity, and, for a time, more or less considerably; such are the cases of simple catarrh of the middle ear. It is even the only local remedy of this disease in very young children, as well in acute as in chronic cases.

Inflation being thus of extremely frequent and general use, I hope the modifications which I recommend will prove useful, by prolonging the good effect of each inflation and rendering repetition less frequent, until a more energetic and

APPLICATION OF PAPER DRESSINGS IN TREATMENT OF PERFORATIONS OF THE MEMBRANA TYMPANI.

By CLARENCE J. BLAKE, M. D., Boston.

Forming, as it does, the boundary between the outer and the middle ear, its outer surface covered by a continuation of the dermoid lining of the external auditory canal, and exposed to the outer air, its inner coat a continuation of the mucous lining of the tympanic cavity, the membrana tympani is liable to participation in the diseases which may affect either of the cavities which it separates, and is also liable to mechanical injury from forces acting from without through the external auditory canal.

Von Tröltsch says: "Three of the most important tissues of the animal system are found in this membrane: integument, mucous membrane, and fibrous tissue; hence pathological changes are very common in this part. Although affections of the membrana tympani are very frequent, exact and unprejudiced observation must show that they seldom occur alone, and uncomplicated with an affection of another part of the ear. The membrana tympani is nourished by the same blood-vessels and nerves that supply the cavity of the tympanum and the auditory canal. It thus really only forms a part of these divisions of the ear. In any affection of the adjacent parts, therefore, the drum-membrane will almost always be involved."

Injuries of the membrana tympani also, says the same author, are quite common, as we would infer from the delicacy

air-douche. Mr. Hewetson's treatment consisted in warm syringing, and the use of alkaline and then astringent instillations, the opening healing perfectly in eight days. It had become partially healed in the interval between the occurrence of the accident and the patient's application for treatment, and the removal of a crust revealed an opening which healed as above stated. In the other case, the ear was simply protected by cotton, the patient being warned not to blow his nose for two days—which injunction he would seem to have punctually obeyed, for, on his return at the end of three days, the rupture had entirely healed. The rules for the treatment of these fresh ruptures would be the same which apply to the treatment of a rent elsewhere: to cleanse the edges from any coagula or foreign matters, and to bring them into apposition and keep them so.

The cleansing may be effected by a little jeweler's cotton on the end of a probe dipped in warm water; and, unless blood has flowed into the middle ear, care should be taken to prevent the entrance of fluid into that cavity. Where the edges of the rent do not fall readily into contact, the contact may be effected by alternately inflating the middle ear and pressing upon the membrane with the probe. The edges of the rent once in place, the patient should be cautioned against inflating the ear for at least forty-eight hours; and, for further protection, the external auditory canal may be stopped with cotton-wool, or, if the edges show a tendency to separate, their continued contact may be further insured by the application of a bit of paper as described further on.

Perforations, the result of mechanical injury, vary greatly in extent, in the shape of the opening, and in their position in the membrane. The posterior half of the membrane is the most frequent seat of these lesions, because the attacking force usually comes from in front; and the size and shape of the opening depend on the character of the instrument, the force of the blow, and the degree of resistance offered by the membrane. Wounds of this sort heal less readily than simple ruptures; the injury to the deeper-seated parts is likely to be greater; the destruction of the substance of the membrane is apt to be more extensive, and the edges of the opening are

by coughing, sneezing, or blowing the nose, which bursts the already-overburdened membrane, and produces a copious discharge. The openings which occur in this manner approach a circular form, and vary greatly in size and position, according to the severity of the inflammation, the degree of pressure, and the length of time during which the membrana tympani has been exposed to its effects, and the condition of the membrane previous to the attack. So far as the treatment of these perforations is concerned alone, this can only follow the treatment of the original disease; so long as there is sufficient discharge to require a vent into the external auditory canal, the opening will probably remain to fulfill that office. In the majority of cases it would be to the patient's benefit if the opening became closed so soon as it was no longer required for this purpose; but while, as is well known, it is extremely difficult to maintain an artificial opening in the membrana tympani, it is almost as difficult to induce the closure of one which has followed an ulcerative process in the middle ear. The advisability of attempting to favor the closure of such a perforation must depend upon the degree of benefit to the hearing, which itself depends upon the perceptive power remaining to the internal ear and the sound-transmitting power remaining to the structures of the tympanum. If the disease has extended to the labyrinth, there is litttle justification in making any such attempt, for in time the mucous membrane of the middle ear exposed to the air undergoes such changes as to render it but little liable to injury from the exposure. In many cases where the inner ear is intact, the changes in the membrana tympani and middle ear are of a character to destroy or greatly diminish the vibratile or sound-transmitting power of the membrane and ossicular chain as a whole; but the sound-waves, gaining admission to the tympanic cavity through the perforation, reach the labyrinth with more or less diminished force. Where, however, the ossicula have been left free to transmit sonorous vibrations, and enough of the surface of the membrana tympani remains to receive and vibrate in response to the impact of the sound-waves, the closure of the perforation will usually considerably improve the hearing. When the opening is a sizable one, more than two millime-

the discharge ceased six months previously; the tympanic cavity was dry, its mucous membrane healthy, and the membrana tympani but slightly opaque; there were no congested vessels or other signs of a progressing reparative process visible; the hearing for the watch was $\frac{5}{180}$. On the 24th of August, 1875, a disk of thin writing-paper, about $2\frac{1}{2}$ millimetres in diameter, was applied, covering the perforation, and the patient directed not to inflate the middle ear for forty-eight hours; the hearing for the watch increased on application of the paper to $\frac{30}{180}$. When next seen on the 18th of October, the hearing for the watch had further increased to $\frac{35}{180}$; an examination of the ear showed the perforation to have become closed by a tense, firm cicatrix, and the piece of paper was discovered on the posterior wall of the auditory canal about half an inch from the meatus, with a thin membrane, formerly a portion of the dermoid coat of the membrana tympani, firmly adhering to it.

The displacement of the paper disks after the closure of the perforation in the cases which have furnished the material for this paper led to a series of observations on the growth of the dermoid coat of the membrana tympani, the results of which will be published later.

Autopsy twenty-four hours after death, at which I was assisted by Dr. Edwin Hutchinson, of Utica, N. Y. The external abscess was located in the lower portion of the mastoid region; about three-fourths of an inch above and slightly behind the meatus was an opening in the squamous portion of the temporal bone about one-third of an inch in diameter. At this orifice, the jagged edge of a small and scale-like sequestrum was observed, which was very movable. On opening the calvarium, about two ounces of fetid, greenish-yellow pus was found in the anterior fossa of the skull, bathing the anterior lobes of the cerebrum, partially filling the lateral third and fourth ventricles, and bathing the medulla oblongata and inferior portion of the cerebellum as far as the foramen magnum. The ventricles were partially lined with a lymphoid-looking material, which was dotted by numerous and minute blood extravasations.

The optic chiasma and anterior portions of the anterior lobes of the brain were covered with lymph, and softened. There were at the anterior and inner portion of the middle fossa a sudden swelling and lifting up of the meninges of about half an inch in diameter, the apex of which presented an aperture communicating with a minute abscess. By pressure, a few drops of very thick, creamy pus were squeezed out.

From the necrosed opening in the squamous portion the meninges were lifted up to such an extent as to cause a communication with the little abscess already mentioned, and presented a surface of detached meninges measuring an inch and three-fourths by three-fourths of an inch in diameter. The tympanum and labyrinth were sawn across, and no disease of any sort was found of the auditory apparatus, except the slight dulling of the dermoid layer of the membrana, before alluded to.

I confess that, during life, I was only able to diagnosticate a mastoid periostitis with abscess.

A child of this age (two months) has few or no mastoid cells, except, perhaps, an antrum, and cell disease is wellnigh impossible.

I infer that the periostitis extended itself to the necrosed

SYPHILIS OF THE COCHLEA (COCHLITIS?).

By D. B. ST. JOHN ROOSA, M. D., New York.

Some three years and a half since, in writing upon diseases of the labyrinth, I stated that I had yet to see a case of recovery from syphilitic disease of that part of the ear.[1] Since that time I have reported one case of cure of syphilis of the cochlea by the use of mercury and potash.[2] I have also very lately seen a similar case in which very great improvement has resulted from an anti-syphilitic treatment; so great a one, that we may hope for much more, since the case has been under treatment but a month. These cases have, of course, made me more hopeful as to the prognosis of syphilitic disease of the labyrinth. They, with some others, that I will now report, have also assisted me to a clearer idea of the symptoms and nature of the disease, although much remains that is unpleasantly obscure, especially as to the pathology. This much is certain, however: The clinical investigation of recent cases will aid us very much in determining just how to distinguish diseases of the labyrinth from those of the middle ear, and perhaps to go a step farther, and locate them in the vestibule, semicircular canals, or cochlea. I beg, therefore, to again report the outline of the first case alluded to, with the additional ones. Before doing so, the symptoms that may be somewhat relied upon in making a diagnosis of disease of the cochlea, and of the other parts of the labyrinth, will be tabulated:

[1] "Treatise on Diseases of the Ear," p. 564.

[2] "Archives of Dermatology," vol. i., part 3.

when these symptoms are present, we must conclude that the cochlea is the seat of disease, even if it be secondarily affected.

5. The diagnosis of *syphilis* of the labyrinth depends in a great measure upon the same kind of evidence as that from which we conclude that a case of optic neuritis or choroiditis is syphilitic; that is to say, the history, and the presence of other symptoms, as eruption, mucous patches, etc. It should not be forgotten, however, that the occurrence of labyrinth-disease, in a person who has probably had the initial lesion of syphilis, even if no other symptoms are present, is a very suspicious circumstance, which should lead to a careful weighing of the indications for and against a mercurial treatment.

I prefer to say disease of the cochlea, instead of disease of the labyrinth, when the prominent symptoms, as in the cases now reported, are great impairment of hearing, the inability to hear certain tones, and the production of false ones. These are evidences, I think, of cochlear disease, whatever else we may have. Tinnitus is a symptom common to many forms of aural affections, while vertigo and unsteadiness of gait are chiefly to be referred to undue pressure from the base of the stapes upon the semicircular canals, and not to disease of the cochlea. I think too much stress has been laid upon increased pressure upon this latter-named part of the ear, to the neglect of disease having its origin in the tone-perceiving apparatus—the cochlea. "Ménière's disease" has always seemed to me an unfortunate name, since it has been indiscriminately applied. It ought not to be used unless it refers to a case such as that in which a hæmorrhage into the semicircular canals was found. Of late, cases in which the cochlear symptoms are, at least, the predominant ones, are sometimes styled cases of "Ménière's disease," when they have very little in common with cases of hæmorrhage. In short, I think we should, in making a diagnosis, begin to localize the part of the ear that is chiefly affected. It is interesting to notice that we are always assisted in a diagnosis of supposed cochlear disease, if the patient have a musical education. I believe all the cases of double hearing that have been reported occurred in musicians. Certainly other patients have had the same symptoms, but they have been unable to appreciate

poor appetite, pains in her legs, and some neuralgia about the eyes. The treatment was anti-syphilitic in the beginning, but has not been very thoroughly carried out of late. The pharynx is granular, and the left drum has no light spot. The usual treatment for catarrh of the middle ears has been pursued to some extent, but with no benefit, for the aural symptoms are increasing.

A thorough anti-syphilitic treatment was undertaken, and, according to a note from the husband, and a verbal communication from the physician who first observed the case, the patient progressed steadily to recovery under this management. I have not seen her since she first consulted me.

Case III.—Mr. U., aged thirty-three, August 30, 1876. The patient states that toward the end of last June he observed dullness of hearing and tinnitus in both ears. Soon after he discovered that he was totally deaf as to the left ear, and the right ear has been growing gradually worse.

On August 1st he began to have attacks of vertigo and staggering, and has had several since. He had a venereal sore on the penis about February 15th, and says he had mucous patches in his mouth and throat about the middle of March.

Hearing distance: R. $\frac{0}{40}$, L. $\frac{0}{40}$.

He hears words when spoken distinctly *into* the right ear. The drum-heads are both dull in color and have no light spots. The air enters both tympanic cavities freely upon the employment of Politzer's method, and reddens the drum-heads, but causes no improvement in hearing.

A diagnosis of syphilitic disease of the labyrinth on both sides was made by my associate, Dr. E. T. Ely, who saw him first; and after the patient had seen Dr. E. L. Keyes in consultation, he was put upon a course of inunction, with the oleate of mercury, mercurial baths, and iodide of potassium internally in steadily increasing doses.

On September 9th he was already better. He could hear the voice much better; the attacks of vertigo continued, but there was no more staggering.

A more complete examination showed some peculiar symptoms, which throw some light upon disease of the cochlea, and

of chronic affections, the same care should be exercised, lest the ears be exposed to loud or continuous sounds.

Case IV. is one that I saw at the Manhattan Eye and Ear Hospital, through Dr. E. T. Ely, who had charge of the patient at the Eastern Dispensary, and who diagnosticated disease of the labyrinth. Mr. L., aged twenty-two, September 7, 1876. Complains that two days ago he was suddenly attacked by complete deafness in left ear, accompanied by noises like "the blowing off of steam." These symptoms have continued, and he has also had slight vertigo and feeling of unsteadiness —most troublesome when he turns his face upward. He had a venereal sore on penis two years ago, and subsequently sore mouth, falling of his hair, and iritis. Was treated for syphilis by reputable physicians.

Hearing distance: R. $\frac{40}{40}$, L. $\frac{0}{40}$. Tuning-fork heard only on right side. Drum-heads somewhat sunken, with dull color and dull-light spot. Air enters middle ears readily through Eustachian tubes, but does not improve hearing.

September 20th.—Patient has been treated for catarrh of the middle ears, without any benefit. Anti-syphilitic treatment was advised at his first visit, but he has refused it thus far.

The diagnosis in this case has not been subjected to the crucial test of treatment. Its syphilitic character cannot, therefore, be so strongly emphasized. Yet, when a history of general syphilis is so distinct, and a labyrinth-affection occurs, I think we may safely conclude that the latter is at least *modified* by the venereal poison, if not actually caused by it.

It is undoubtedly true that affections occur in syphilitic patients (from suppression of the perspiration, for example) which would have occurred all the same had they not been syphilitic; and yet, the exposure or imprudence having once caused the attack of inflammation, it immediately assumes the character of a syphilitic affection, by reason of the syphilitic blood, whose increased flow to the part, and the exudation, go to constitute the inflammation. The complete failure of the anti-catarrhal treatment, although all these patients showed some catarrhal symptoms, was another striking evidence of the real nature of the cases, for we seldom meet with cases of

HYPEROSTOSIS OF THE MASTOID.

By J. ORNE GREEN, M. D., Boston.

The inflammations of the mastoid, to which so much attention has been given of late years, have been proved to consist not of one single but of various pathological conditions, according as the mucous membrane lining the cells, the bone itself, or the external periosteum bears the brunt of the inflammation, all of the different varieties, however, arising from and caused by a primary inflammation of the mucous membrane of the tympanum, which extends back into the mastoid cells, and serves as a periosteum to the internal or tympanic surface of the temporal bone. In fact, both the tympanic and mastoid inflammations are essentially a periostitis in the interior of the temporal bone.

As the result of this periostitis in the interior of the mastoid cells, we may have any one of these conditions: 1. The inflamed membrane may secrete pus, and fill the cells, producing the so-called abscess within the mastoid; 2. The inflammation may extend from the cells along the minute vessels and periosteal projections, which penetrate the bone through its innumerable foramina, and thus set up a periostitis on the external surface of the mastoid; or, 3. An inflammation of the bone itself (an ostitis) may be caused.

This ostitis may be either purulent or hyperplastic. When purulent, we may have, as the result of the inflammation and the accompanying exudation in the tissues of the bone, absorption of the whole bone, as is seen in those cases of mastoid disease in which the bone is perforated by the inflammation;

with dizziness, and at the same time the discharge from the ear, which had been profuse, ceased entirely. At the time of his entrance to the hospital, record gives the following condition: "Seems to be of feeble understanding; complains of headache, especially behind the left ear, and general weakness; is unable to stand on account of dizziness; often makes ineffectual attempts to speak; often cannot fix upon or pronounce the word he wants; says he knows the word he wants to use but cannot pronounce it; tongue thickly coated in centre; pulse 72 and regular; temperature 101.2°; no appetite; marked thirst; bowels moved this morning; mouth drawn slightly to the left side; tongue protruded straight; left eye injected, and left pupil slightly more dilated than the right; headache increases at night; does not sleep well." He was ordered a mixture of bromide of potassium and chloral hydrate.

June 1st.—A. M. All the symptoms were worse; the paralysis of the right side of the face, the opposite side from the ear-disease, had increased; the pain was worse; the stupor was more marked, and when roused he was unable to speak intelligibly, although he seemed to understand questions. Pulse, as before, 72.

At 2 P. M. I saw him in consultation with Dr. Edes. The facial paralysis on the right side was more marked than in the morning; the tongue for the first time was protruded toward the right side; his speech was utterly unintelligible; stupor extreme; pulse, 72. On examination of the ear, I found no swelling or œdema externally over the mastoid; meatus slightly congested in its deeper parts; membrana tympani swollen and red, with a perforation on the anterior lower segment of the size of a pin's head, through which thick purulent matter exuded. The mastoid and the parts just below the auricle between the mastoid and jaw were tender on pressure, and there was slight swelling behind the angle of the jaw.

It was decided to perforate the mastoid, and, under ether, the bone was exposed just behind the auricle; the mastoid cells opened by means of a trephine one-fourth of an inch in diameter; the bone removed was very dense, and seven-six-

There is now a free discharge of purulent matter from the tympanum through both wound and meatus; the douching is continued every two hours through the day and omitted during the night. An instillation of sulphate of zinc, gr. j, ad. ℥j, twice a day, was ordered for the tympanum. Pulse variable from 70 to 60, temperature also variable from 97.5° to 98.4°.

June 10*th.*—There is a decided improvement; no stupor; the paralysis of both face and tongue is less, and he can speak much more distinctly; is able to recognize the word he wishes to use, but cannot always succeed in pronouncing it; has taken milk, toast, and eggs in fair quantities, but this morning vomited breakfast. Pulse very variable, from 45 to 70, temperature normal. He was ordered brandy and milk iced, and the bromide of potassium was omitted.

June 14*th.*—Has been gaining in every way; paralysis has almost disappeared; his speech is much better; there is no pain or dizziness; he complains of some subjective noise in the ear; discharge from meatus and wound has nearly ceased; examination shows the swelling and redness of the membrana tympani and meatus to have nearly disappeared; air passes freely through the tympanum with a perforation whistle on catheterization.

June 17*th.*—Pulse still very variable and irregular, from 42 to 108. No marked change till to-day, when there is a decided loss of strength and appetite without any known cause; is unable to retain anything except brandy and milk.

June 19*th.*—Improving in strength and appetite; paralysis of tongue has disappeared, and that of face improving daily; no discharge from meatus or mastoid cells, and the cloth tent which has been kept in the wound is removed; the douching is used only once a day, and the water passes freely into the throat from both wound and meatus.

July 10*th.*—The paralysis has entirely disappeared; appetite and strength good, and the patient has been walking about for the last week; the wound is closed to a mere sinus, and no diseased bone is felt; was discharged from the hospital.

The patient reported once a week for the next month; there was some slight return of the headache of short dura-

be possible by thorough douching of the whole cavity to allay the local inflammation. Although the prognosis was considered very unfavorable at the time on account of the extent to which the brain must be involved, it was hoped that by relieving the inflammation of the ear the inflammation of the brain might subside when the irritation which was causing it was removed. The opening of the mastoid cells showed that there was no collection of pus in them. As the direct effect of the operation, the patient expressed himself relieved, which may be referred either to the free bleeding or the douching of the tympanum. The next morning, however, the improvement was marked; he was able to express himself perfectly intelligibly; there was very little stupor; the paralysis of the face was much less, and that of the tongue had disappeared. The two slight convulsions on the second day after the operation marked an increase again in the brain trouble, although the pain in the head and the stupor did not return; the pulse also began to fall below the normal. Examination of the hearing power, previously impossible on account of the stupor, showed it to be fair, and excluded the labyrinth from participation in the inflammation. For the next few days the brain symptoms, although marked, were never as severe as before the operation.

Following this was a decided improvement in every symptom except the pulse; the paralysis of the face disappeared; his speech became nearly perfect, and there was no pain, stupor, or dizziness; the pulse, however, continued very variable, ranging from 42 to 108 per minute, but gradually became normal as convalescence set in. On leaving the hospital he had been absolutely without symptoms for nearly two weeks. During the next three months a few attacks of general headache, the last and most severe one about ten days before death, were the only symptoms complained of, but, notwithstanding these, he had gained in flesh and strength.

The acute inflammation of the brain in the beginning, the period of latency for three months, only interrupted by a few attacks of headache, and the sudden fatal termination, would seem to point to abscess of the brain-tissue which finally ruptured.

The very decided improvement which followed the opening of the mastoid cells and the treatment of the tympanic inflammation, although followed by a partial relapse, is of interest, as in a similar case of less severity it might be the means of so reducing the inflammation that it could subside without causing serious changes in the brain.

2. *Chronic Purulent Inflammation of the Tympanum; Hyperostosis of the Mastoid; Perforation of the Mastoid; Recovery.*—Albert X., aged eleven, applied to me in December, 1875, for an acute exacerbation of a chronic purulent inflammation of the right tympanum. The old otorrhœa was the result of scarlet fever two years before, and had been continuous from the beginning. For about a week before I saw him he had had severe pain in the ear, and over the side of the head, with slight febrile disturbance. Examination showed the right membrana tympani nearly destroyed, and the position of the posterior half of the membrane occupied by a mass of firm, fibrous granulations; Eustachian tube pervious; mucopurulent discharge in the meatus in moderate quantity; no tenderness or swelling of the mastoid. The inflammation of the tympanum was treated by leeches and douching with warm water; but, in spite of this, in a few days, the mastoid became very tender on pressure, and œdematous externally, and the periosteum was incised freely under ether; no pus had formed, and the bone was not softened. The operation was followed by decided relief to the pain in the ear and the tenderness of the mastoid; but in a few days the pain returned with greatly-increased severity, and with increased constitutional disturbance; rapid pulse, nausea, dizziness, and complete loss of appetite. The pain was not referred to the interior of the ear as at the beginning of the attack, but directly to the mastoid process. Opening of the mastoid process was agreed to and performed under ether, with the assistance of Dr. John Homans, a few hours after, the pain having increased very much in the mean time in the mastoid. After exposing the bone by an incision through the periosteum, it was perforated by means of a triangular borer, one-seventh of an inch in diameter, on a level with the meatus, the point of the instrument being directed slightly forward.

It was impossible to recognize when the instrument perforated the inner plate of bone, but occasional examination with the probe showed finally that the mastoid cells had been opened at the depth of one-fourth of an inch from the external surface of the bone, and the end of the probe could be passed into a small cavity. No pus was found, nor could anything be syringed from the cells; water in minute quantities could be forced through the opening into the meatus.

The operation was followed by gradual relief from the pain in the next few days; the wound was kept open by cloth tents; douching of wound and meatus with warm water continued, and eventually the water passed from the opening into the meatus in somewhat larger quantities than at first, but never freely. The granulations of the tympanum became gradually covered with epidermis, the tympanic inflammation subsided, and the discharge ceased.

The wound was kept open for some six weeks, or till all inflammatory symptoms had subsided, and at no time was there an appreciable suppuration from the interior of the bone. It finally closed firmly by granulations without any caries or necrosis, and has remained firm for five months, although there has recently been a slight return of tympanic inflammation, due to a cold.

3. *Purulent Inflammation of the Tympanum; Inflammation of the Subcutaneous Tissue externally; Hyperostosis of the Mastoid; Perforation; Recovery.*—Mrs. D., aged twenty-seven; strong and healthy; was seen in December, 1875. Eleven months before, from a cold, she had an acute purulent inflammation of the right tympanum, and, since then, has had a continuous otorrhœa on that side, with more or less pain. Seven months from the beginning of the attack, soon after confinement with her third child, a swelling, the size of a pullet's egg, appeared a little above and behind the right auricle. From that time there has been unilateral headache on that side, marked tenderness of the swelling, and pain in the ear, gradually becoming worse, till I saw her, when she was in high fever with chills, and rapid pulse, anxious countenance, and complete loss of appetite.

Examination of the ear showed a slight purulent discharge,

the membrana tympani destroyed, and its position occupied by a firm swelling of the mucous membrane; Eustachian tube slightly pervious. The tumor, which had not increased since its first appearance, was a little above and behind the auricle; was red, firm, immovable, and circumscribed, but without fluctuation; there was no swelling or tenderness of the lower part of the mastoid; there were no decided brain symptoms.

Under ether an incision was made through the tumor down to the bone; no pus was found, and the bone was not softened. The tumor seemed to be a non-suppurative inflammation of the subcutaneous tissue. A poultice was applied, and morphine ordered *pro re natâ*.

The free bleeding from the incision and the relaxation of the tissues gave decided relief to the pain, headache, and fever, and the tumor slowly disappeared by suppuration, so that in a fortnight the wound had healed, and no vestige of the tumor remained, except a little induration. Soon after, however, pain and tenderness developed themselves in the point of the mastoid, with occasional sharp burning pain on the left side of the vertex of the head, and the otorrhœa continued. In spite of leeching and douching the ear, and poulticing the mastoid, the pain increased in the ear and mastoid, and there were also dizziness, nausea, and pain in the occiput, which made me fear brain-trouble; at no time was there, however, any return of the fever or marked change in the pulse. The mastoid was now opened under ether, as in the previous cases, by means of the triangular stilet of a trephine; the cavity was only reached after perforating to the depth of about half an inch; water could be syringed through to the throat and meatus in small quantities; no pus was evacuated.

The wound was kept open for six weeks, and treated by douching and poulticing, and the tympanic inflammation was treated in the usual way. The direct effect of the operation was not evident, but the pain and tenderness of the mastoid slowly improved, and in four weeks had disappeared. After being kept open six weeks till all otorrhœa had ceased, and the tympanic mucous membrane had assumed a tolerably healthy appearance, the wound healed.

Occasional dizziness, nausea, and pain in the vertex and

occiput, were felt for the next three months, and occasionally there was a slight recurrence of tenderness of the mastoid, which passed off with poulticing. The pulse and temperature continued normal. For the last three months the patient has been free from symptoms, and is well apparently.

4. *Acute Purulent Inflammation of the Tympana; Hyperostosis of One Mastoid; Perforation; Recovery.*—Sarah S., aged twenty-four, not strong, but without special disease; subject to severe tonsillitis, with which there was four years ago acute catarrhal inflammation of both tympana, from which she recovered perfectly under treatment. In the latter part of January, 1876, she was seized with chills, sore-throat, headache, cough, and anorexia, and again developed a severe inflammation of both tonsils; two weeks from the beginning of the illness she became very deaf, and on February 16th entered the City Hospital. At the time of entrance both tonsils were much swollen, nearly occluding the passage to the fauces; the right one the largest, and somewhat ulcerated on its surface. Some pain in both ears, but not severe; deafness extreme. Pulse 70, temperature 98.4°, respiration 20. Mouth-wash of chlorate of potass. and sulphate of quinine, gr. iij, 4 times daily, was ordered.

On the 21st I saw her for the first time. There had been a severe chill lasting half an hour during the previous night. Examination of the ears showed purulent inflammation of both tympana, with ruptures of both drum-membranes; no tenderness of the mastoids. Douching and hot-water instillations were ordered for the ears; the quinine was omitted.

The chills recurred daily during the next eight days, but gradually became less severe. The inflammation of the tonsils and of the tympana slowly improved, and the general condition was better; the discharge from the ears diminished, and Politzer's inflation was used daily, giving a distinct perforation whistle on each side; the hearing improved. On March 1st, however, decided but not extreme tenderness with slight œdema was noticed over the lower points of both mastoids. Poultices were ordered over both mastoids.

March 1st, P. M., pulse, 104; temperature, 100.5°; respiration, 26.

2*d*, A. M., pulse, 80; temperature, 97.2°; respiration, 18; P. M., pulse, 76; temperature, 100.2°; respiration, 20.

3*d*, A. M., pulse, 72; temperature, 98.2°; respiration, 20; left mastoid better, the right still tender; pain over right half of head; P. M., pulse, 64; temperature, 98.6°; respiration, 16.

4*th*, A. M., pulse, 80; temperature, 98°; respiration, 18; P. M., pulse, 68; temperature, 98°; respiration, 16.

5*th*, A. M., pulse, 68; temperature, 99°; respiration, 24; confined to bed with weakness; P. M., pulse, 68; temperature, 98.8°; respiration, 15.

6*th*, A. M., pulse, 56; temperature, 96.8°; respiration, 14; P. M., pulse, 68; temperature, 98°; respiration, 20.

7*th*, A. M., pulse, 84; temperature, 98°; respiration, 20; right mastoid improving, left one not sensitive; free discharge from right meatus, very little from left; P. M., pulse, 60; temperature, 97°; respiration, 14.

8*th*, A. M., pulse, 72; temperature, 98°; respiration, 18; P. M., pulse, 68; temperature, 97.8°; respiration, 16. Up and dressed.

9*th*, A. M., pulse, 64; temperature, 97.2°; respiration, 16.

11*th*, A. M., pulse, 96; temperature, 98.8°; respiration, 28.

12*th*, P. M., pulse, 92; temperature, 101.4°; respiration, 26. Complains of headache all over the head; delirious at times.

13*th*, A. M., pulse, 100; temperature, 99.5°; respiration, 22—to-day recurrence of tenderness and swelling over left mastoid with increased discharge from left tympanum and diffuse inflammation of left meatus; right mastoid better; discharge from right tympanum much less; five leeches to left mastoid; frontal headache and pain in occiput; Dover's powder, *pro re nata*—P. M., pulse, 88; temperature, 99.4°; respiration, 20.

14*th*, A. M., pulse, 74; temperature, 97.4°; respiration, 20; P. M., pulse, 90; temperature, 98.7°; respiration, 24.

15*th*, A. M., pulse, 80; temperature, 98°; respiration, 18; P. M., pulse, 74; temperature, 97.4°; respiration, 18.

16*th*, A. M., pulse, 60; temperature, 97.2°; respiration, 16.

Tenderness of left mastoid less, and for the next four days seemed to be improving, although the left mastoid continued

decidedly sensitive but not painful. The right ear was healed. The inflammation of the tonsils had subsided.

March 22*d*.—A recurrence of diffuse inflammation of the left meatus with loss of appetite and occasional slight vertigo.

24*th*.—While at breakfast appeared faint and could not speak; no loss of motion or sensation; no convulsion. When I saw her half an hour after, she was extremely restless, trying to get out of bed, and pointing to the forehead and back of head, as if there was pain at these points; no nausea or vomiting. Pulse, 100. An ice-bag was applied to the head and she soon dropped to sleep, and awoke in an hour perfectly conscious and able to speak; she remembered nothing of the attack.

Similar but less severe attacks recurred several times during the next few days. The left mastoid continued tender, but without œdema or pain. Slight, ill-defined headache most of the time, referred chiefly to the left side.

March 25*th*, A. M., pulse, 80; temperature, 97.8°; P. M., pulse, 87; temperature, 98.3°.

26*th*, A. M., pulse, 96; temperature, 98.2°; P. M., pulse, 92; temperature, 99°.

27*th*, A. M., pulse, 94; temperature, 98°; P. M., pulse, 90; temperature, 98.2°.

28*th*, A. M., pulse, 84; temperature, 98.3°.

To-day patient first consented to an operation which I had been desirous of performing for several days on account of the marked head-symptoms. The left mastoid was opened under ether by a triangular borer on a level with the meatus, as in the previous cases, and the cells were reached only after perforating the bone for more than one-fourth of an inch. Nothing was evacuated. The wound was kept open by a cloth-tent, and the opening douched once a day with warm water which was felt slightly in the throat. A flaxseed poultice was applied.

28*th*, P. M., pulse, 102; temperature, 97.8°.

29*th*, A. M., pulse, 108; temperature, 97.5°; very decided relief to the headache, and no recurrence of unconsciousness or delirium; P. M., pulse, 104; temperature, 99°.

30*th*, A. M., pulse, 114; temperature, 98°; P. M., pulse, 120; temperature, 100°.

31*st*, A. M., pulse, 120; temperature, 98.4°; slight chill with inclination to faint, soon better; no loss of speech or consciousness; from this time convalescence was uninterrupted; P. M., pulse, 92; temperature, 99.4°.

April 1*st*, A. M., pulse, 112; temperature, 98.3°; P. M., pulse, 96; temperature, 98.8°.

5*th*.—The use of tents was omitted and the wound healed rapidly, and on April 10th she was discharged. Two months afterward she remained well.

In all of these cases the thickness of bone which was perforated, varying from one-fourth of an inch in a child of eleven years to half an inch in an adult, would leave no doubt in regard to the existence of hyperostosis. The difficulty which was experienced in passing water through the mastoid into the tympanum, even after the perforation had entered a distinct cavity, as proved by the probe, would show that the same condition existed within the cells as in the external wall.

In none of the cases was there any history of previous mastoid disease, and three of them may be regarded as instances of more or less acute hyperostosis. In the fourth case, following acute purulent inflammation of the tympanum, there would seem to be no possibility of referring the disease to any long-continued disease, as the ears had been previously healthy; in two of the other cases there had been, it is true, chronic tympanic inflammation for a long time, but the mastoid trouble was very recent; in the last case (No. 3) there had been mastoid inflammation probably for months.

In three of the four cases the mastoid disease was accompanied by pain, usually severe, referred by the patient not only to the ear but also to the mastoid itself; in the fourth there was no decided pain in the mastoid. In all four cases there was marked tenderness of the bone on pressure; in only one, however, was there any œdema or other symptom of external periostitis. In all of them a series of ill-defined symptoms, headache, nausea, and dizziness, were present, which would lead any one familiar with the insidious way in

which the brain is affected from purulent tympanic inflammation to fear trouble with the brain; in none, however, except the one fatal case, was there any very great or long-continued variation of the pulse.

In all of the cases, I am confident that the mastoid cells were opened; indeed, in each I was able, although with difficulty, to force water into the meatus or throat, but notwithstanding this no pus or anything else was evacuated from the cells. In the first and fourth cases the relief from the operation was very marked and immediate; in the other two cases the effect of the operation was not so decided, although they both gradually improved from that time, and eventually recovered. In the first case the relief to the brain symptoms was very decided, and I can only explain the final fatal termination by supposing that a local intense cerebritis had been set up in some part of the brain, which failed to be relieved when the rest of the brain was relieved of its congestion.

It is noticeable that in none of the cases was the operation followed by severe febrile reaction; in fact, in most of them there was no febrile disturbance noticed after the operation.

In the series of mastoid cases reported by Schwartze in the *Archiv für Ohrenheilkunde*, vols. x. and xi., five cases of hyperostosis are given, in which perforation of the cells was performed or attempted; in two of these the operation was followed by almost immediate relief to the pain and other urgent symptoms; in two others the operation gave gradual relief; while in the fifth case there were no urgent symptoms present, the operation being undertaken for a necrosis.

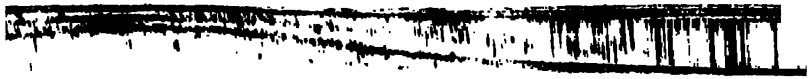
Dr. Buck, in his admirable article on mastoid disease in the "Archives of Ophthalmology and Otology," vol. iii., says, in speaking of hyperostosis, that, "while this form constitutes a distinct pathological condition, we are not yet in possession of sufficient clinical facts to guide us to a positive diagnosis;" and in his description of the disease says, "Its progress is so insidious, and so rarely accompanied by any marked symptoms, that it is only at the *post-mortem* examination, or when called upon to trephine the bone, that we discover the existence of this condition." That the diagnosis is as yet uncertain, these cases have convinced me, but they also show that the disease

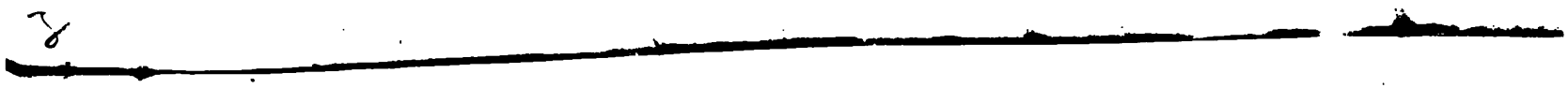
may be accompanied by very marked symptoms simulating those of the other varieties of mastoid inflammation. Again, he speaks of this hyperostosis as associated often with "a deposit of cheesy material produced by a retrograde metamorphosis of pus, epithelial cells, and mucus," a condition undoubtedly found in *post-mortem* examinations, but in these cases of mine a careful examination with the syringe and probe failed to develop anything of the kind, and I think it more likely that such deposits are rather the result of a long-continued inflammation of the internal periosteum than of the true hyperostosis. Certainly such deposits are not necessarily associated with the acute or subacute hyperplasia of the bone.

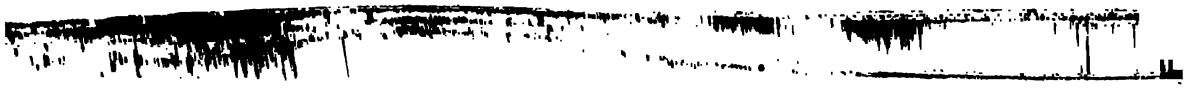
At a meeting of the Paris Academy of Sciences in 1875, Prof. Gosselin read a paper on "Osteo-neuralgia of the Long Bones,"[1] in which he advocated trephining in all cases of diseased bone, whether inflammatory or neuralgic, in order to relieve the pain if not to cure the disease. From the cases of hyperostosis of the mastoid which have been reported, and from my experience in these cases, I think the same rule could be applied to the inflammatory diseases of the mastoid bone. Of ten cases of mastoid hyperostosis with which I am familiar, and in which the bone was perforated, nine were relieved, and the tenth case proved to have a necrosed sequestrum not loosened;[2] in five of these cases the operation was followed by relief to pain and other severe symptoms within a very short time (one to three days), while in the other four the relief was more gradual.

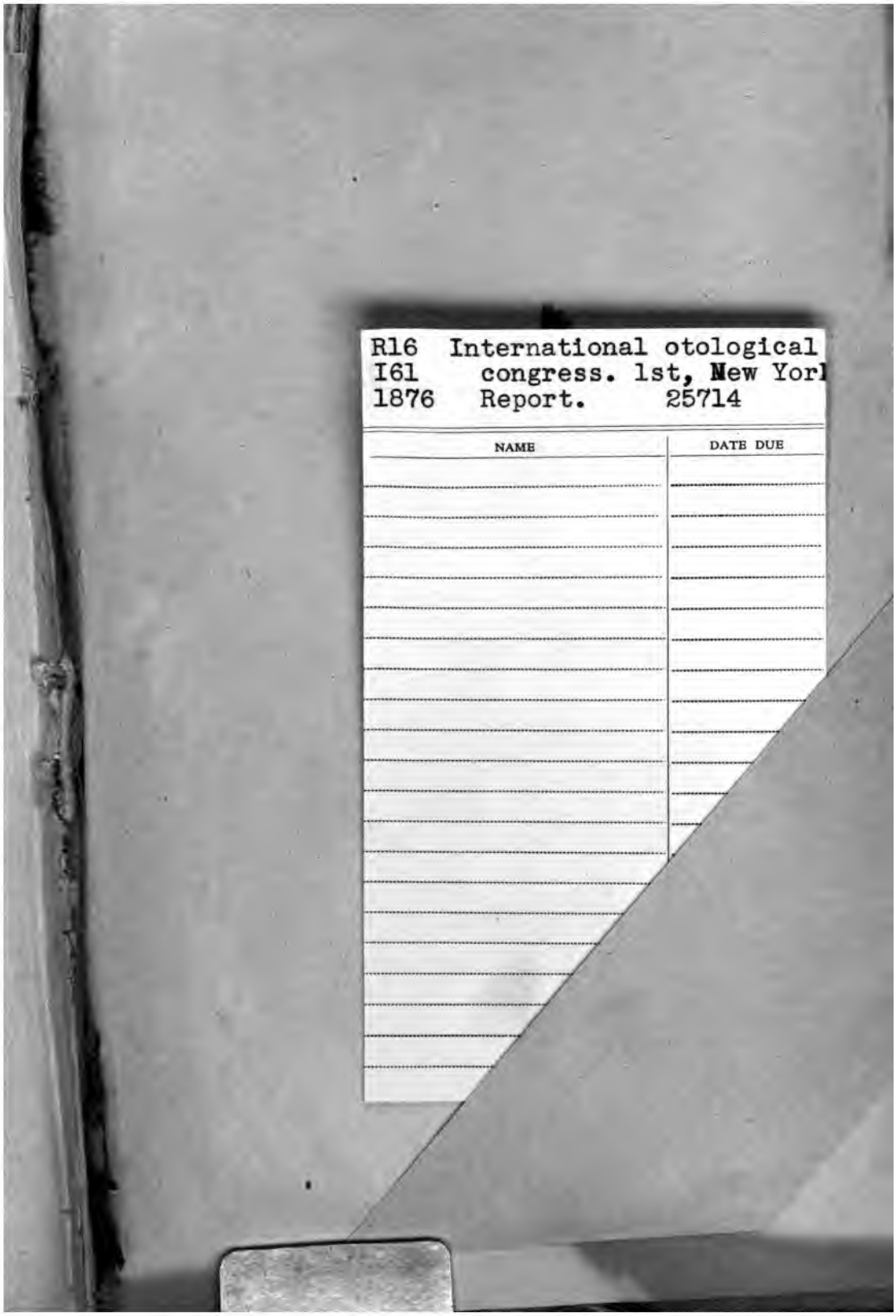
[1] *British Medical Journal*, November 13, 1875. Paris Letter.

[2] Five cases by Schwartze, *op. cit.* From here reported. One by Dr. Agnew, American Otological Society, 1870.





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